SERVICE INSTRUCTIONS

BENDIX-SCINTILLA
CAST, FILLED
AIRCRAFT IGNITION HARNESS

Used on

PRATT & WHITNEY R-2800

AIRCRAFT ENGINES

SCINTILLA MAGNETO DIVISION
BENDIX AVIATION CORPORATION
SIDNEY, NEW YORK, U. S. A.

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FORM L-147-2

SPECIFICATION NUMBERS AND PART NUMBERS OF COMPONENT PARTS OF HARNESSES COVERED BY THIS INSTRUCTION

Ign. Harn. Assy. Incl. S/P. Leads	Ign. Harn. Assy. Less S/P. Leads	Lead Set Part Number	H. T. Lead Part No.	Supercharging Pump Part No.	Rotation Direction
10–33220–1	10–33220	10–32836 Plus H. T. Leads	2 Units of 10–28801	10–29578Y–1	Anti
10–33300–1 Up to Change A	10–33300	10–32704	Not Included	10–29607Y–1	Clw
10–33300–2 Up to Change A	10–33300	10–32704 Plus H. T. Leads	10–38996 10–38995	10–29607Y–1	Clw
10–33300–1 Change A and After	10–33300	10–32804	Not Included	10–29607Y–1	Clw
10–33300–2 Change A and After	10–33300	10–32704 Plus H.T. Leads	10–38996 10–38995	10–29607Y–1	Clw

THE FOLLOWING INFORMATION IS INCLUDED FOR REFERENCE PURPOSES AND COVERS HARNESSES OF EARLY EXECUTION WHICH ARE NO LONGER MANUFACTURED

10–28320–1	10–28320	OBSOLETE—SUPERSEDED BY 10–33220–1
10–30270–1	10–30270	OBSOLETE—SUPERSEDED BY 10–33300–1
10–30275–1	10–30275	OBSOLETE—SUPERSEDED BY 10–33220–1
10–32700–1	10–32700	OBSOLETE—SUPERSEDED BY 10–33300–1
10–32700–2	10–32700	OBSOLETE—SUPERSEDED BY 10–33300–2

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SECTION I

DESCRIPTION

A.– General Information

This radio-shielded harness and distributor assembly is supplied for use with the Pratt and Whitney R–2800 engines. It operates in conjunction with a nose mounted, eighteen cylinder double magneto. Figure 1 shows the relation of the component parts of the assembly. Two rotary air pumps are incorporated, one in each distributor. The purpose of these pumps is to maintain adequate air pressure in the distributors and magneto at high altitudes. An automatic venting device or "Altitude Valve" is installed on each distributor, and two of these valves are also used on the magneto. Remaining open at low altitudes, the valves provide a free flow of air for ventilation purposes at low levels. At high altitudes, the valves automatically close, thereby maintaining the pressure in the magneto and distributors, and affording the necessary protection against flashover.

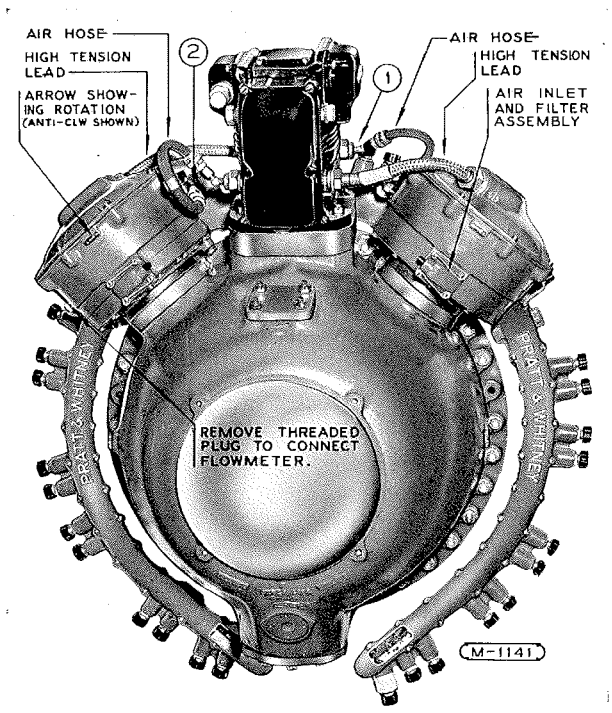


Figure 1
The Cast, Filled Harness and Distributor Assembly as Installed on the Engine

B.– Harness Manifold

The harness manifold and the two distributor housings are magnesium castings, permanently bolted together. Each distributor contains eighteen equally spaced electrodes. (See figure 2.) Each electrode is mounted on an individual insulating bushing assembled into the bowl. (See figure 3.) Cables within the cast manifold connect the distributor electrodes to their respective manifold outlet sockets which are provided for the attachment of the spark plug leads. The conduit passageways within the manifold are filled after wiring with a plastic compound which protects the cables from moisture, oil, and chafing.

High tension current from the magneto enters the distributor through a terminal in the cover. An electrode in the terminal conducts the current to the center electrode of the distributor finger by means of a jump gap. From the finger electrode it is distributed to the electrodes of the various spark plug high tension cables at the proper firing interval of the engine.

C.– Supercharging Pump

The rotary air pump in each distributor is driven directly from the engine. A seventeen tooth drive coupling on the lower end of each pump shaft engages a mating spline in the engine, geared to turn at ½ crankshaft speed. The upper end of the pump shaft carries the distributor finger. Vernier ratchets are provided on the pump drive coupling for timing the finger.

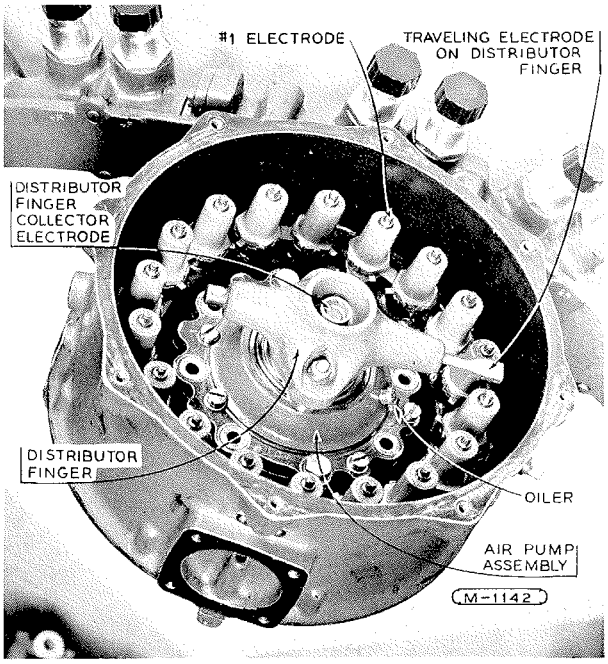


Figure 2
Distributor with Cover Removed to Show the Air Pump

The pump is of the vane type.(See Figure 4.) The air is brought into the pump from outside the bowl through a filtered intake, then up through the base of the pump to the intake port. The compressed air from the pump exhausts directly into the distributor bowl. From each bowl, air is forced through a tube to the magneto. A small bleed hole in a plug at the bottom of the bowl provides ventilation for the distributor. Although fastened by screws, the distributor bowl is integral with the manifold and must not be loosened or removed.

D.– Altitude Valves

Figure 5 shows a cross-section view of the altitude valve. Four of these are used on each system. The valve consists of a permanently sealed air cell "E",

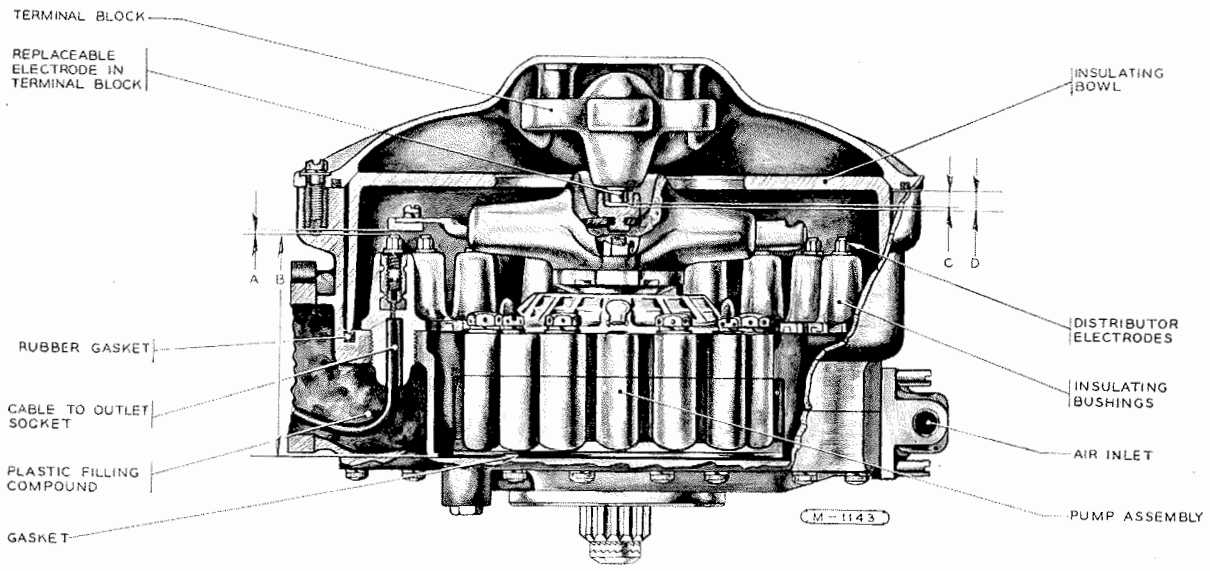


Figure 3
Sectional View of Distributor

one wall of which is a rubber diaphragm "D". This diaphragm is directly over the walls "C" of the outlet passage, through which air escapes from the magneto and passes out of the holes "B" in the valve body, when the valve is at low altitudes.

At high altitudes the air cell "E" expands by reason of the lowered atmospheric pressure in chamber "A". This pushes the diaphragm "D" against the escape passage wall "C", closing off the valve and maintaining the pressure in the system.

For detailed information covering the maintenance & test of the altitude valve refer to the Service Instructions (Form L–222) for the Altitude Valve.

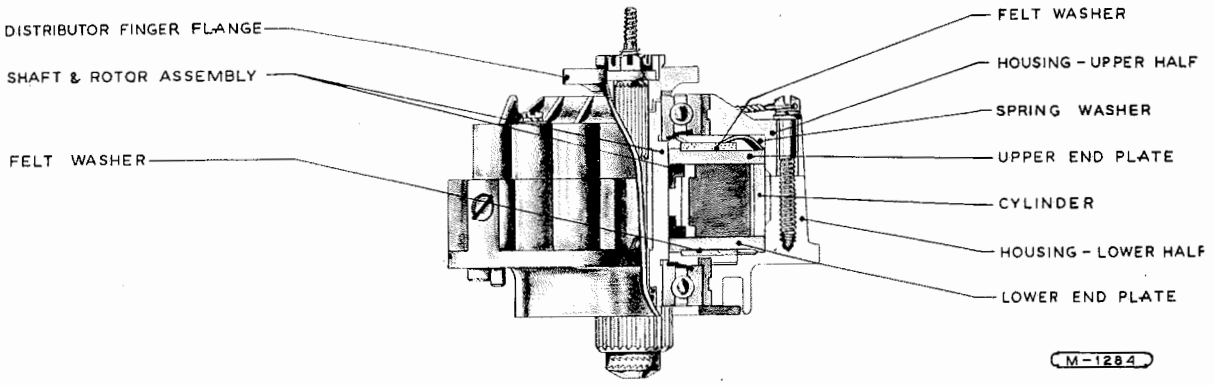


Figure 4
Sectional View of Spring-Loaded Type Air Pump

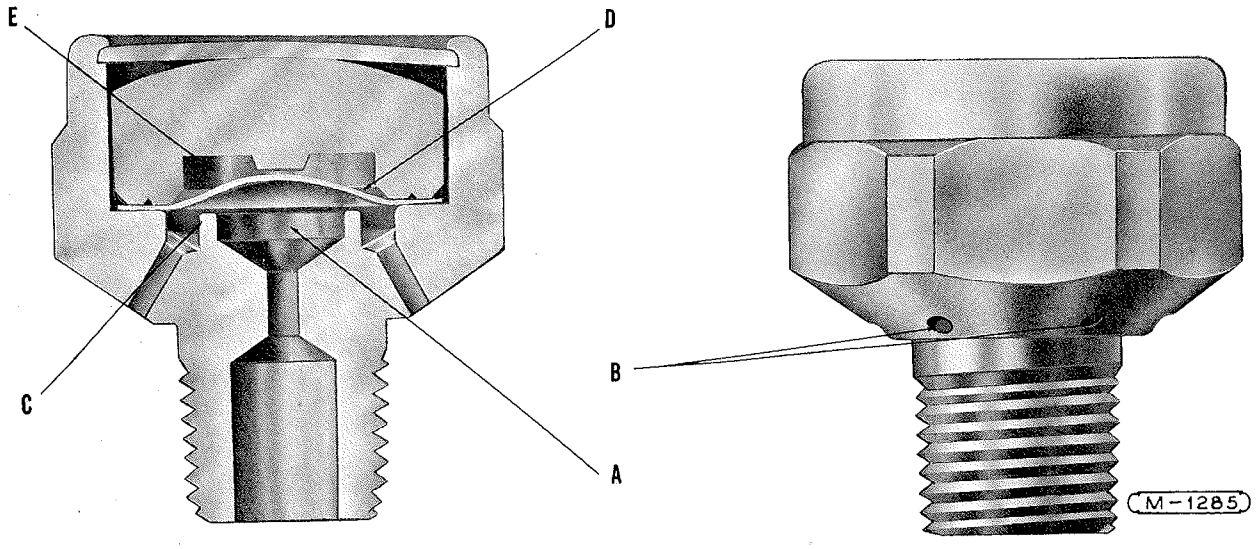


Figure 5
View of Sectioned and Complete Altitude Valves

SECTION II
INSTALLATION, TIMING AND CHECKING

A.– General Instructions

Before installing the harness and pumps, make sure that both are of the correct rotation to suit the requirements of the engine. A rotation arrow is provided on each distributor bowl showing the rotation for which the manifold is wired. (See figure 1.) Each pump is stamped with an arrow for the same purpose. The pumps will not function if operated in the wrong rotation. Where specifications refer to pumps or harnesses as "clockwise" or "anticlockwise" this is determined *as one faces the drive end of the pump shaft* and not as one looks into the distributor bowl or engine mounting pad.

Note: *Owing to the position of the harness on the engine, it is necessary that the manifold be installed BEFORE installing the magneto. For a similar reason, the magneto must be removed when disassembling, before the harness can be removed.*

B.– Harness Manifold and Distributor Head Assembly

Remove the distributor covers and take out the insulating bowls and the pumps. Place the harness manifold assembly in position on the engine. Insert the two lower bracket securing screws, at the same time placing the spacers in position. Engage these lower screws only enough to hold the harness loosely. Insert the gaskets in position between each distributor bowl and the engine, lining up the bolt holes.

C.– Supercharging Pumps

Place the pump gasket in position in each distributor bowl and install the pump, entering the pump intake pipe into the inlet recess in the distributor housing.

Note: *The pump is provided with a dowel pin which engages loosely in a hole in the pump mounting surface of the distributor. This dowel is located differently on clockwise assemblies than on anticlockwise, to prevent accidental use of the wrong rotation pump with a particular rotation of harness.*

When installing the eight screws which secure each pump and distributor, it is important to make certain that there will be no binding due to eccentricity between the pump spline and the engine spline. To prevent binding the following procedure should be followed.

1. Run the screws in each pump down just tight enough to compress the lock washers slightly.
2. Turn the engine through at least two (2) complete revolutions of the crankshaft. With the screws only partly tightened, this procedure will allow the pump to move and center with the engine mating spline.
3. Draw the securing screws down carefully and evenly, making sure the pump is not shifted or cocked when the screws are tightened. Safety wire the screws after tightening.

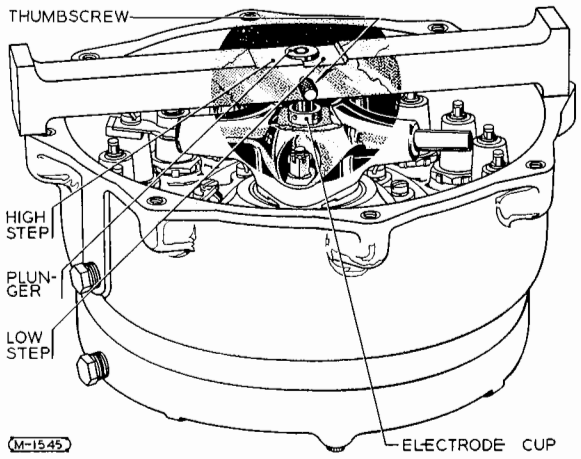
After completing the installation of the pumps, tighten and safety the two lower bolts which secure the manifold to the engine.

D.– Distributor Finger

1. General Information.

In the installation of the distributor finger, three requirements must be fulfilled:

1. The outer or traveling electrode must be set to obtain the correct clearance of .029″ ± .019″ with the stationary electrodes in the distributor bowl. This clearance (Dimension "A" in figure 3) is checked with the No. 11–1899 gage or with an equivalent feeler gage.
2. The center electrode (cup) in the top of the finger must be correctly located in relation to the cover mating surface of the distributor bowl so that the bottom of the electrode cup is .242″ ± .017″ below the cover mating surface of the bowl. This clearance (Dimension "D" in figure 3) is checked with the No. 11–3120 gage as illustrated in figure 6.



NOTE: LARGE DIAMETER SURFACE OF PLUNGER MUST NOT COME BELOW LOW STEP NOR ABOVE HIGH STEP.

Figure 6
Gage Applied to Collector Cup Electrode on Finger

3. The distributor finger must be correctly timed in relation to the electrodes in the bowl so that the traveling electrode is in proper relation to the No. 1 electrode when the engine is set at its full advance No. 1 cylinder firing position.

Note: *To expedite and simplify the procedure of installing the distributor finger, it is recommended that the distributor finger mounting flange on the top of the pump be shimmed to the assembly dimension of 2.613 ± .003″ as outlined in the pump overhaul instructions. If the distributor finger mounting flange has been previously shimmed in this manner, the correct electrode clearances mentioned in requirements 1, and 2, above should*

automatically result and it will probably not be necessary to change the distributor flange shims when installing the unit on the engine. With the pump shimmed in this manner, it is simply necessary to time the finger in the correct relation to the number one electrode of the distributor, as outlined under "Timing The Distributor Finger". The clearances should then be checked as a precautionary measure, and will usually be found correct.

Unless it is known for certain that the distributor finger is already shimmed to the correct height, it is advisable to make a preliminary check of the clearance under the traveling electrode and this should be done before timing the finger because changing the shims would upset the finger timing adjustment.

2. Procedure.

a. Preliminary Check (may be omitted if finger flange is already shimmed)

Place the distributor finger in position on its mounting flange and while holding the finger firmly and squarely down on the flange check the clearance between the traveling electrode and the bowl electrodes with the No. 11–1899 gage or an equivalent feeler gage. The clearance should be not less than .010″ nor more than .048″. Also check the position of the center electrode cup on the finger in relation to the cover mating surface at the top of the distributor bowl. This is checked with the No. 11–3120 gage and should be not less than .225″ and not more than .259″.

To use the gage, first slightly loosen the thumbscrew (see Figure 6) so that the plunger slides freely. Then place the gage squarely across the distributor bowl in the position shown in figure 6, having the end of the plunger pushed firmly down against the bottom of the electrode cup on the finger. When this is done, the large diameter surface on top of the plunger should come between the high and low steps of the gage bar, indicating that the finger electrode is in the correct relation to the cover mating surface of the bowl.

If either of the above clearances are outside their respective limits, remove the distributor finger and take off the distributor finger mounting flange. Change the amount of shims under the flange as necessary to obtain the correct electrode clearance. Then reassemble and recheck clearances.

If it is necessary to change the shims, care should be taken in reassembling the flange to make sure all shims are lined up properly so they do not interfere under the flange when it is being reinstalled.

b. Timing The Distributor Finger.

As previously stated, the distributor electrodes are spaced at equal intervals around the bowl. However, since the magneto has compensated cams, the sparks are delivered at unequal intervals. To provide for these variations, the traveling electrode on the finger is designed with sufficient width to give coverage for all sparks. However, it is necessary that the finger be correctly adjusted in relation to the No. 1 electrode of the distributor.

The correct position for the distributor finger in relation to the No. 1 electrode, is governed by the No. 1 "E" gap of the magneto. At the present time, all magnetos used with this harness assembly have a No. 1 "E" gap of 11° and therefore the following instructions cover only the method of setting the finger for use in connection with a magneto having an 11° cam.

Set the engine crankshaft at the exact No. 1 cylinder firing position on the compression stroke in the manner prescribed by the engine manufacturer. Remove the distributor finger and loosen the finger flange securing nut two full turns. This will allow the adjusting ratchets on the drive end of the distributor shaft to be operated when the finger is turned by hand. Place the finger temporarily on its flange again, having the dowel hole in the finger engaged with the pilot dowel in the flange.

Observe the No. 1 electrode of the distributor. This electrode is stamped with a "1" in the bowl casting adjacent to the insulating support bushing. Adjust the ratchets so they will be in full engagement at the position where the leading edge of the traveling electrode just covers the No. 1 electrode as shown in Figure 7. This is done by turning the finger back and forth until the ratchets click into full engagement at the instant the finger electrode lines up with the No. 1 electrode. Turning the finger to the right one click moves it 15°: then turning it back to the left one click moves it 15.65°, leaving a resultant change of .65° to the left, which is equal to about $^1/_{32}$ inch of travel of the end of the tool. After the correct setting has been obtained, take off finger and use the following procedure for tightening the nut:

1. Tighten the nut finger-tight.
2. Grasp the finger flange and rock it back and forth by hand while turning the nut up snug with a socket wrench. Rocking the finger back and forth as the nut is tightened will insure that the ratchets are fully meshed.
3. If this procedure is not followed, the nut might be tightened with the ratchets incompletely meshed, in which case they might loosen in operation.

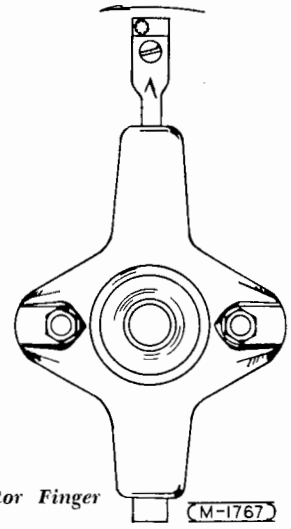


Figure 7
Timing the Distributor Finger

After tightening the flange securing nut, recheck the setting to make sure the adjusting ratchets did not shift when the finger was tightened. If the setting is satisfactory, lock the nut with a cotterpin, being sure to bend the cotterpin around the sides of the nut in the special manner shown in figure 8.

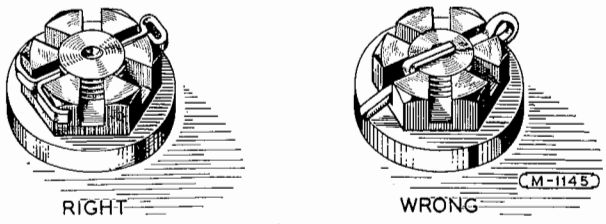


Figure 8
Installing Cotterpin in Distributor Finger Flange Nut

E. – Magneto, Distributor Cover, and High Tension Leads

1. Magneto.

Install the magneto to the engine at this time. For information covering the installation of the magneto, refer to the magneto service instructions.

2. Distributor Cover and Center Electrode.

The high tension electrode in the distributor cover must be shimmed to obtain .010″ to .030″ clearance between this electrode and the bottom of the cup electrode on the finger (dimension C subtracted from dimension D in figure 3). This clearance is adjusted by the installation of No. 10–33633 shims under the high tension electrode. The No. 10–33633 shims are 20 thousandths of an inch thick. To determine the correct amount of shims, the No. 11–3120 gage is used.

To use the gage, first slightly loosen the thumbscrew (see figure 6) in the side of the gage so that the plunger is free to slide up and down. Then place the gage squarely across the distributor bowl in the position shown in figure 6, having the end of the plunger in the electrode cup on the distributor finger. Push the plunger firmly down against the bottom of the cup. When this is done, the large diameter surface on top of the plunger should be between the low step and the high step on the top of the gage, indicating that the electrode cup is in correct relation to the parting surface of the bowl.

If the plunger indicates correctly when firmly pushed down against the bottom of the cup, lock it in this position by means of the thumbscrew. Remove the gage from the distributor bowl and locate the two screw holes in the cover which will mate, upon reassembly, with the two screw holes in the bowl over which the gage was placed in taking the bowl measurement. Apply the gage to the cover over these mating holes in the position shown in figure 9. Notice that the other side of the gage is used for the cover. Also make sure the legs of the gage are against the cover parting surface, and not touching the sealing strip in the cover.

Now look at the underside of the gage and observe the relation between the central electrode in the cover and the steps on the bottom of the plunger, as shown in the enlarged view (figure 10). The central electrode in the cover should hit the "NO GO" step (small diameter) and should clear the "GO" step (large diameter), and if it does so, the electrode is correctly shimmed and ready for use. If the electrode clears the "NO GO" (small diameter) step, install shims (No. 10–33633) under the electrode so as to bring it up to the required position. If the electrode hits the "GO" (large diameter) step, remove shims from under the electrode.

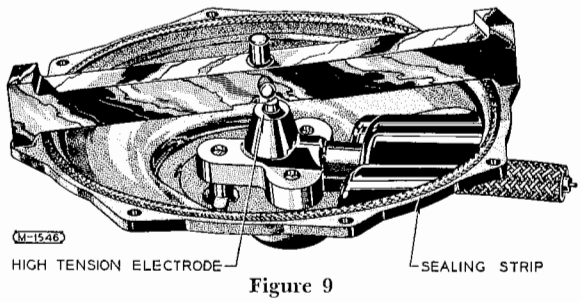


Figure 9
Gage Applied to Hi-Tension Electrode in Cover

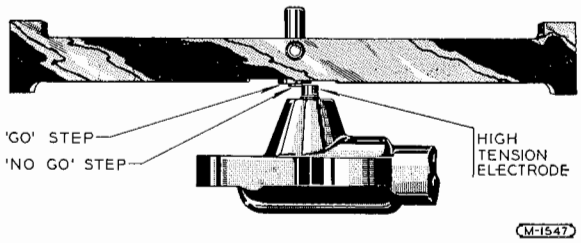


Figure 10
View of Gage Applied to Center Electrode

Note: *Since the tolerance on the gap clearance is .020″ and the shim thickness is .020″, it could theoretically happen that the electrode would clear the "NO GO" step on the first reading – and then would hit the "GO" step when a shim was installed. From a practical standpoint this is unlikely, but if it should happen, leave the shim in position because it is desirable to keep the gap as short as possible and under the circumstances it will be only a few tenths of a thousandth under the specified minimum.*

Caution: *It will be necessary to re-shim the center electrode in the cover by the above procedure whenever any of the following parts are changed or replaced:*

1. *Distributor cover*
2. *Terminal Block in Cover*
3. *Center Electrode in Terminal Block*
4. *Distributor Finger*
5. *Shims under Finger Mounting Flange*
6. *Pump*
7. *Pump Gasket*

3. High Tension Leads.

The high tension leads must be installed to the magneto and distributor covers before placing the latter in position. Coat both terminals of the lead lightly with DC–4 compound. Then insert the lead into the magneto. Start the coupling nut on its threads but do not tighten. Then insert the other end of the lead into the cover, and start coupling

nut threads in the same manner. Now install the cover to the distributor and secure in position. After installing the cover, tighten both coupling nut threads, making sure the lead is not twisted or cramped when the nuts are being tightened. Safety the coupling nuts at the magneto by wiring to the magneto mounting stud.

F.– Air Pressure Tubes

Install the air tubes which lead from each distributor to the magneto. The correct position of these tubes is shown clearly in figure 1. All coupling nuts and elbows should be drawn up snugly to prevent shaking loose and resultant air leakage. When tightening the hose coupling nuts use a second wrench and hold the hose ferrule to prevent twisting the hose. Threaded caps on the magneto must be safetied after tightening. This is done by wiring to the magneto mounting stud.

G.– Spark Plug Leads

Do not remove the outlet protector caps until ready to install the leads.

To install the leads, first apply a thin film of DC–4 compound to the lead terminal insulators. Then take off protector caps and push lead terminal down into socket. Turn the securing nut on the socket up finger tight.

Thread the rear spark plug leads through the cylinder baffles. Insert spark plug ends of leads in their respective wells, making sure ferrule is seated against plug barrel before starting the nut. Then tighten finger tight.

Beginning at the spark plug end, secure the spark plug leads with the clamps provided so that the leads have an easy lay. (No short bends or twists.) Then finally tighten the spark plug terminal nuts and the manifold outlet nuts up tight, using not over an eight inch wrench and making sure not to twist the lead shielding when the nut is turned.

H.– Air Inlet Lines

Remove the plastic thread protector plugs, and connect the inlet lines provided on the engine, to the air inlets of the distributors. The system is now ready for operation.

I.– Installation Check of Supercharging System

A performance test of the system should be made before high altitude flight is undertaken, in order to make certain that proper air pressure will be maintained for the prevention of electrical flashover.

The simplest method of making this test is to connect a manifold pressure gage to one of the plugged openings on the distributors or magneto and observe the pressure in the system when the engine is run up on the ground. Use a tube long enough to locate the gage where it can be read while the engine is being run up.

Operate the engine at 2000 rpm for long enough to get a stabilized reading on the gage. Since the manifold pressure gage reads in terms of absolute pressures, the prevailing atmospheric pressure must be subtracted from the reading obtained at 2000 rpm to obtain the actual gage pressure in the system.

1. Systems NOT Equipped With Altitude Valves.

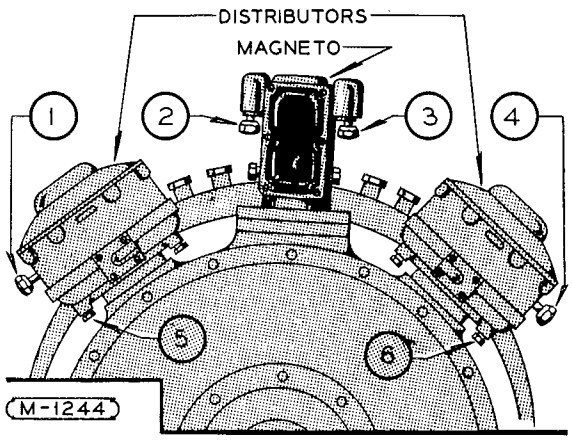
For systems not equipped with altitude valves, the gage pressure obtained at 2000 engine rpm should be at least 10″ hg. or approximately 5 p.s.i. and not over 19″ Hg. (Approx. 9½ p.s.i.) If the pressure is less than 10″ hg. or over 19″ Hg. the first step in correcting the trouble is to make a flowmeter check of the system. If the incorrect pressure is due to excessive leakage, or to plugged orifices, it will be revealed by this check, which is made as described under heading 3 in this section.

If the flowmeter check shows normal leakage, the incorrect pressure is undoubtedly due to either insufficient or excessive pump output. If the pressure is less than 10″ hg. this may be due to either low pump output, or to excessive leakage at some point of the system. Low pump output may result if one of the pumps has been "bled" by drilling a hole in the inlet port plug. Under the present test specification, pumps which deliver in excess of 19″ hg. pressure are required to be "bled" for use in systems not incorporating altitude valves, in order to keep the output below the maximum of 19″ hg. This "bleed" is accomplished by drilling an .039″ diameter hole in the plug which is installed in the inlet port of the pump body. If the test pressure is outside the recommended margin the pumps should be inspected to see if they incorporate these bleeds. Subnormal pressure can be raised by replacing a drilled plug with a solid one, while excessive pressure can be corrected by drilling the inlet plug on at least one of the pumps. Details of the drilling operation are given in the section on pump testing. Should it be found that a system with low pressure has solid inlet port plugs in both pumps, it is a safe assumption that one or both of the pumps is defective, in which case new pumps which have been tested to the correct pressure values, should be installed.

2. Systems Equipped With Altitude Valves.

For systems equipped with altitude valves, the gage pressure obtained at 2000 engine rpm should be at least 2″ hg. Pressure in excess of 2″ hg. indicates an efficient system in general, however, should the pressure exceed 10″ hg. it is usually a sign that one or more of the altitude valves are plugged and all valves should be checked for proper flow before operating the system. Valves should be checked as outlined in the separate instruction manual (Form L–222) covering the altitude valve. If the pressure is low, first inspect visually to make sure all of the valves and plugs are in proper position. Correct location of the valves and plugs is shown in figure 11. If valves and plugs are all in order, conduct a flowmeter test as described in paragraph 3 of this section.

If the flowmeter check shows normal leakage, the low pressure is undoubtedly due to insufficient pump output. Remove distributor covers and see if either pump incorporates a bleed vent. If so, remove bleed vent and install a plain plug in its place as a means of restoring pressure in the system. Pump intake bleed vents should *NOT* be used in systems which incorporate altitude valves.



LOCATION OF THE ALTITUDE VALVES ON THE 18 CYLINDER IGNITION SYSTEM FOR R-2800 ENGINES.

Figure 11

Location of Altitude Valves

3. Using the Flowmeter.

To provide a convenient means of making leakage tests of the system the No. 11–1757 flowmeter has been made available. Operating instructions are supplied with the instrument or upon request.

In preparing to make a flowmeter test, it is always necessary to remove the air inlet couplings from the distributors and plug the air inlet holes with standard 1/8" pipe plugs. Also if the system incorporates altitude valves they must be removed before using the flowmeter. The altitude valve outlet on the left distributor must be replaced with a 1/8" pipe plug, while the valve outlet on the right distributor is used for the flowmeter connection. (See figure 12.) In addition, the altitude valves on the magneto must be replaced with .016" diameter orifice plugs when making the flowmeter test. Figure 12 shows the correct location of the distributor plugs and vents. While the valves are removed from the system, it is advisable to test them for proper operation.

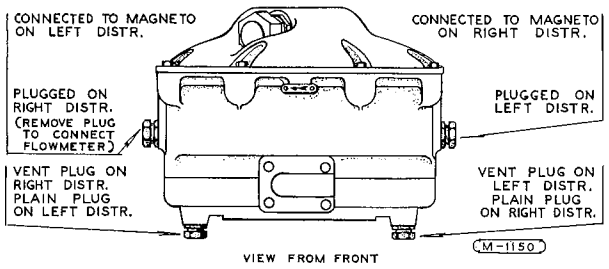

CONNECTED TO MAGNETO ON LEFT DISTR.
CONNECTED TO MAGNETO ON RIGHT DISTR.
PLUGGED ON RIGHT DISTR. (REMOVE PLUG TO CONNECT FLOWMETER)
PLUGGED ON LEFT DISTR.
VENT PLUG ON RIGHT DISTR. PLAIN PLUG ON LEFT DISTR.
VENT PLUG ON LEFT DISTR. PLAIN PLUG ON RIGHT DISTR.
VIEW FROM FRONT
M-1150

Figure 12

Location of Plugs and Vents on Distributor Bowl

Remove the threaded plug (figure 1), or altitude valve (figure 11) from the side of the right distributor assembly and attach the threaded nipple and hose assembly of Bendix-Scintilla No. 11–1757 flowmeter. Connect the other end of the hose assembly to the nipple marked "OUT" on the flowmeter. Connect an air supply line to the nipple marked "IN" on the flowmeter. The meter is now ready for use. Operate the flowmeter in accordance with the instructions provided with the instrument and conduct the leakage test of the system. If the flowmeter check shows a leakage of BETWEEN 38–62 cubic feet per hour, the system is satisfactory.

If the leakage is less than 38 C.F.H., inspect the vent plugs of the magneto and distributors to see that the small drilled holes in these plugs are not obstructed. Refer to figure 12 and to the magneto instruction manual for location of the drilled plugs.

If the leakage IS MORE THAN 62 cubic feet per hour, the system is leaking excessively and further tests must be made to locate the points of leakage. External leaks can usually be located by brushing a mild soap and water solution over all joints and parting surfaces of the system while maintaining pressure on the interior. Appearance of bubbles indicates a leak.

If the soap and water technique fails to locate the excessive leakage, there is a possibility of internal leakage of one of the units. In this case the distributors and magneto should be checked separately and investigated further in accordance with the following table.

Unit	Permissible Leakage		Probable Cause to be Checked*
	Min.	Max.	
Magneto	10 CFH	15 CFH	Drive shaft oil seal defective.*
Either Distributor	14 CFH	21 CFH	Defective air seal in lower bearing. Defective pump gasket.

*Based on the assumption that all external joints have been checked with soap and water and found to be satisfactory.

SECTION III
INSPECTION AND MAINTENANCE

A.– 200 Hour Intervals

1. Lubrication.

After each 200 hours of operation the pumps should be lubricated. Loosen the coupling nut of each high tension lead at the magneto. Take out the distributor cover securing screws and remove the distributor cover, at the same time pulling the high tension lead out of the magneto. Take out the insulating bowl which is directly underneath the cover. Observe the two oilers on the pump. (One of the oilers can be seen in figure 2.) Place ½ tablespoon of S.A.E. No. 10 oil in each oiler. If possible, oil while distributor is warm.

2. Cleaning.

At the same 200 hour interval, remove any dirt or oil which may have accumulated in the distributor bowl. Use a clean dry cloth for this purpose. Do not use any cleaning fluids.

Clean the dielectric surfaces of the distributor finger, high tension terminal bushings, insulating bowl, and the terminal block in the cover with a clean cloth dampened in acetone. Then wipe with a dry clean cloth.

Caution: *Allow at least ½ hour for any traces of acetone to evaporate before replacing covers.*

3. Inspection.

a. Dielectric Surfaces

Examine all dielectric parts for evidence of carbon tracks or cracks. This applies to:

1. High tension electrode bushings.
2. Distributor finger.
3. High tension terminal block in cover.
4. Insulating bowl.

b. Lead Coupling Nuts

Try the coupling nuts of the spark plug leads for tightness. These nuts must be kept tight to prevent entry of moisture and provide proper radio shielding. HOWEVER, DO NOT STRAIN THEM BY EXCESSIVE FORCE. The object of this check is to make sure that none of the nuts have loosened, and this can easily be determined by a moderate pull using a small wrench.

c. Inspection of Intake Filters.

At 200 hour inspection periods, or whenever a test of the system shows the pressure to be low, remove the air intake pipe and take off the air inlet and filter assembly from each distributor. Clamp the air inlet casting lightly in a vise and pry out the filter cartridge by means of a screw driver applied as shown in figure 13.

Inspect the back face of the felt for excessive dust and dirt which might prevent free flow of air through the filter. If filter is very dirty, install a new filter cartridge. Cleaning of these cartridges is not recommended. However, in an emergency the filter could be cleaned in carbon tetrachloride and then blown with compressed air. The air

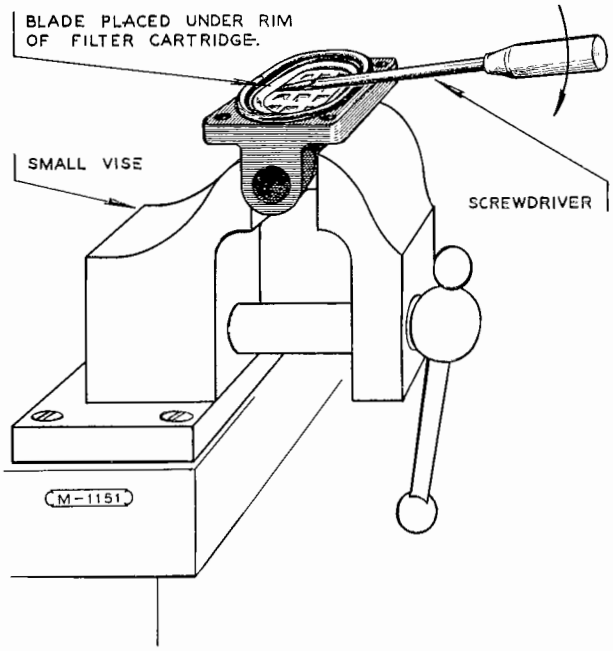


Figure 13
Removing Filter Cartridge from the Air Inlet

should be blown through the filter from the cleaner side. CAUTION: DO NOT USE GASOLINE, OR ANY INFLAMMABLE OR COMBUSTIBLE FLUIDS TO CLEAN THE FILTER. If such solvents should remain in the felt until the engine was started the vapors might explode in the distributor. When replacing the filter cartridge in the inlet casting, install it with the same side out as originally.

d. Inspection of Electrode Surfaces.

Inspect the high tension electrodes for burning and erosion. These electrodes are subject to a certain normal burning which gives them a blackened appearance. However it is not necessary to replace an electrode unless it is severely burned and eroded over the entire surface. Refer to the instructions in Section V for replacing electrodes and see figure 3 for electrode setting dimensions.

B. – Electrical Trouble Shooting

1. General Information.

If proper care has been taken in the original installation of the system, it is believed that very little electrical service will be required between overhauls. However, should operating difficulties develop which appear traceable to the ignition system, an electrical check may be conducted to locate the source of the trouble.

Any electrical test should be conducted with care. A number of testers now on the market impose severe electrical strains on the harness, and if used improperly, such testers can permanently damage insulation which might otherwise be restored to serviceable condition. This refers particularly to

moisture troubles – for example – troubles which might originate in the manifold sockets if the spark plug leads were incorrectly installed, thereby permitting moisture to get into the socket. Frequently such troubles can be corrected by cleaning the socket thoroughly, and then drying the harness to remove moisture (refer to Section V). However, if a high power tester is connected across the moisture-weakened insulation and operated at high output it can very quickly put enough current through the defect to burn the insulation and carbon track it, making necessary a complete manifold overhaul and rewiring job.

Experience has shown that the most reliable and safe method of testing a harness is by means of a high-voltage direct current tester. For this reason the direct current method of testing is recommended in preference to any procedure employing alternating current in the test circuit.

2. Recommended Voltages for Testing.

For exploratory testing to locate ignition trouble, a voltage of NOT OVER 10,000 VOLTS should be used. This is the peak or maximum voltage. For testers having an alternating current output this is equivalent to 7,100 R.M.S. volts.

3. Procedure For Electrical Trouble–Shooting Test.

a. Remove the distributor covers and clean the dielectric surfaces of the high tension electrode bushings with a clean cloth moistened in acetone.

b. Disconnect all spark plug leads at the plugs. Clean the spark plug terminals of the leads to remove the insulating compound, and then wipe the dielectric part of the terminal with a clean cloth moistened in clear unleaded gasoline.

c. Connect the ground lead of the harness tester to the harness manifold. Turn the engine until the high tension electrode of the distributor finger is over the number one electrode of the distributor. Connect the high tension lead of the tester to the spark plug end of any wire EXCEPT THE NO. 1 CYLINDER SPARK PLUG WIRES and conduct test as instructed by tester manufacturer. After all wires except No. 1 have been tested, turn propeller about a quarter turn and then test No. 1 spark plug wires.

d. Keep the tester on each wire only long enough to bring the voltage up to the required value and observe the leakage indicator of the tester. Prolonging the test increases the possibility of damaging the harness insulation.

e. If the tester indicates leakage on any wire SHUT OFF THE POWER AT ONCE. Remove the spark plug lead. Clean up the terminal at the manifold end of the lead and test the lead separately. If lead is defective, replace it with a new one, which should be installed as instructed in paragraph "C" of this section.

f. If lead is satisfactory, the trouble may be in the manifold socket. Clean out the compound and wipe the interior of the socket with a small cloth swab moistened in clear unleaded gasoline. Care should be taken to avoid distorting the spring in the bottom of the manifold socket. Inspect socket for foreign material which may be lodged under the spring. Wipe out socket with a dry cloth.

g. Reinstall lead and repeat test of manifold. If leakage is still indicated, try a new lead. If leakage persists, the manifold must be replaced.

h. Owing to the design of the harness, it is impossible to replace a defective wire without completely rewiring the manifold. At the present time the manifold must be returned to the factory for this work. However before returning a manifold to the factory, read Section V of these instructions entitled "Heating Harness to Remove Moisture."

C. – Replacement of Spark Plug Leads

Keep new spark plug leads clean. Do not remove the lead protector caps until ready to install the lead on the manifold.

Before installing a new lead, remove all old compound from the manifold socket and the spark plug well. Make sure the socket and well are both clean. Then coat the lead terminal LIGHTLY with D.C. No.4 insulating compound and install the new lead, observing the precautions mentioned in Section II, paragraph G.

SECTION IV
PUMP OVERHAUL

A.– Removal of Pump

Remove distributor cover and insulating bowl. Using socket wrench No. 11–1395, take off the two nuts which secure the distributor finger and lift off finger. Remove the eight screws which secure the pump, and lift the pump out of the distributor.

B. – Disassembly

Note: *When disassembling, always keep the parts of each pump assembly together. Do not interchange pump parts, or try to salvage parts from one pump for repair of another unless the instructions specifically state that this is permissible.*

Remove the cotterpin from the distributor finger flange securing nut. Take off the nut with a socket wrench, using No. 11–1239 spline wrench to hold the pump drive coupling. Remove distributor finger flange and shims. Keep shims together. By applying a slight pressure on the threaded end, push out the drive shaft, releasing the drive coupling, ratchet, and spring. Remove the safety wires from the four screws on the top of the pump and take out the screws. Insert the point of a screw driver in each of the two slots provided, and pry up the upper half of the housing slightly, after which it can be lifted off. Take out the felt washer, the large spring washer if used, and the upper end plate.

Remove the rotor shaft, rotor, and the vanes. Mark the rotor with a red pencil so it can be reassembled same side up as originally. Should the shaft and rotor assembly stick, use a fiber drift and tap it lightly at the drive end to start it. Remove the rotor from the shaft. (It may be necessary to drive this out also.)

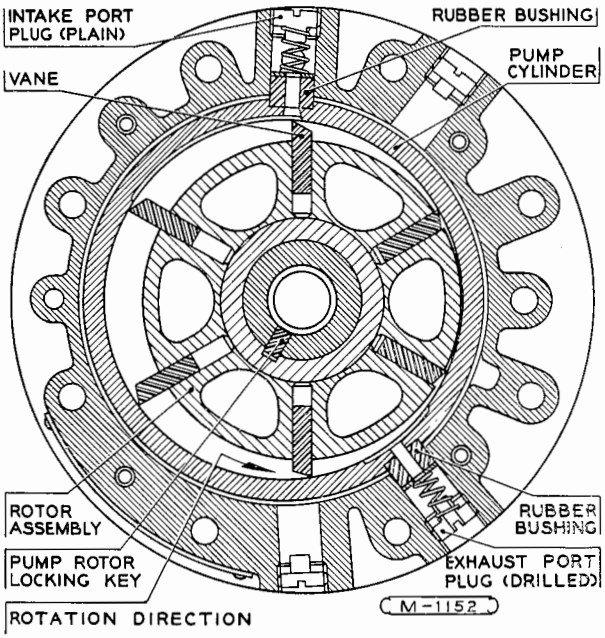


Figure 14
Sectional View, Looking Down on Clockwise Pump

Remove the intake port plug and the exhaust port plug (figure 14) from the lower half of the housing. These plugs are unpainted and are not staked. (Do not remove the plugs which are staked and painted.) Take out the springs and plain washers.

Insert the hooked end of No. 11–3116 tool through the rubber bushing in each port and pull the rubber bushing back slightly until it just clears the counterbore in the cylinder. (See figure 14.) The cylinder, lower end plate and felt washer can then be lifted out. Mark the lower end plate with a red pencil, so that it can be placed in its original position during reassembly. After removing the cylinder, push the rubber bushing back and take it out from inside the housing. The threads in the housing may be damaged if you try to remove the bushings from the outside. Push out the ball bearing from the upper support with the hand. If it sticks, press it out with No. 11–1815 pressing tool in an arbor press. Take out the six screws which secure the retainer for the lower ball bearing and remove retainer. This bearing can be pushed out by hand. DO NOT PUT THE BALL BEARINGS IN ANY CLEANING FLUID. They are sealed bearings and cannot be repacked. Washing will contaminate the original lubricant.

C. – Inspection

1. End Plates.

Inspect end plates for scoring or excessive wear. They are normally smooth, showing a polished appearance over the ring shaped area where the vanes contact them. If plates are scored badly they should be replaced. In an emergency, a scored plate can often be made serviceable for temporary use by smoothing off the projecting burrs of the scoring with a very fine oil stone and then polishing with crocus cloth.

2. Cylinder.

Clean the milled recesses adjacent to the inlet and exhaust ports of the cylinder, removing any dried oil or dirt. Inspect cylinder for scratches and scoring. Minor scoring of the cylinder is not cause for rejection. However, if cylinder is very rough or burned, make necessary replacements. Do not try to stone the inner surfaces of the cylinder.

3. Rotor and Shaft.

Inspect pump rotor and shaft for rust where the parts fit together. Rust can be removed with crocus cloth. Inspect the steel thrust washers, to see that they are tight in place.

Inspect Woodruff key in the shaft. The key should fit tightly in the shaft, otherwise air may leak around it and escape through the pump drive shaft. Do not remove the key from the shaft unless it is loose or defective. If necessary to install a new key it should be pressed into position rather than driven, and must be worked down lightly on the sides with sand paper so that the shaft will be an easy

hand fit into the rotor without the key binding at any place.

4. Vanes.

The vanes are not subject to much wear and usually do not need replacement. However they should always be checked for proper slot clearance and end clearance when assembling the pump as instructed under "Reassembly" in this section.

5. Bearings.

The sealed type bearings cannot be visually inspected or repacked with lubricant. However they should be checked for roughness by holding the inner race in the fingers and slowly turning the outer race. If the bearing does not turn smoothly it is an indication of rough spots on the races or balls and the bearing should be rejected. Normal bearings will turn with a noticeable drag which is due to the friction of the air sealing member. This drag is quite even, however, and should not be confused with the rough and uneven action of a defective bearing. If a bearing is found which turns very freely or "coasts," it indicates excessive wear of the air sealing member which is likely to leak in service. Such a bearing must not be used in the lower half of the housing.

Open type bearings which are used in the upper support of some pumps can be inspected in the usual manner.

6. Housing.

Blow out all air passages in the housing with compressed air. See that the oilers are open and clean and make sure all dowel pins and inserts are tight. If either half of the housing is defective, a complete new housing assembly must be used.

7. Felts.

The felt washers should be soft and pliable. If hard and dry, it is recommended to replace them. However they can be reconditioned if necessary by soaking in S.A.E. No. 10 oil.

D.– Reassembly

1. Lower Ball Bearing.

Install the ball bearing into the lower half of the housing, so that the air seal (the side carrying the manufacturer's stamp) will be toward the rotor. Secure this bearing with its retainer and six screws, and stake retainer so as to turn up a small burr into each screw slot.

2. Lower End Plate.

Saturate the lower felt washer with S.A.E. No. 10 oil and place it in position in its recess, having the hole in the washer centered over the hole in the lower bearing. Make sure the interior of housing is clean and free from any dirt particles which might prevent the lower end plate from seating properly. Then place the bottom end plate (which was marked with red pencil) in position, having the flat surface of the plate up, and engaging the milled notch in the edge of the end plate with the locating dowel which projects in the housing.

3. Cylinder.

Before installing the cylinder in the pump, check the cylinder height with a micrometer as shown in figure 15, and note this measurement for reference in checking the vanes. The cylinder is a rather tight fit, so a little care is necessary in putting it into position. First make sure it is right side up for the particular rotation of pump you are working on. If the cylinder is inserted wrong side up the pump will not operate. The short milled slot in the cylinder must line up with the open exhaust port in the housing, at the same time having the long milled slot lined up with the open intake port. See that the cylinder is clean before placing it in position. Turning it a little as it is inserted may help to prevent binding. Do not force it. Seat the cylinder down squarely against the lower end plate. Then look into the open intake and exhaust ports and shift the cylinder a little if necessary so the holes in it are exactly centered under the ports in the housing.

4. Rubber Bushings.

Push the rubber bushings into the intake and exhaust ports. The No. 11–3116 tool is used for this purpose. Push the bushings in as far as possible until they engage the counterbores in the cylinder. Then install the plain washer, spring, and screw plug in position over each bushing. Use a solid screw plug in the intake port (marked LI or RI) and the hollow plug in the exhaust port (marked LE or RE) as shown in figure 14. If the pump originally incorporated a drilled intake port plug, replace it with a solid one when reassembling. Stake plugs in position after tightening.

5. Rotor, Rotor Shaft, and Vanes.

Install the rotor shaft into the rotor, using a light film of Andok "C" grease on the outer surface of the shaft. The end of the shaft having the internal spline must be at the end of the rotor which was marked "Top" during disassembly. (A new rotor can be installed either end up.)

Then apply a liberal coating of S.A.E. No. 10 oil to the interior of the cylinder and to the rotor, and install the rotor and shaft into the pump with the internally splined end of the shaft up.

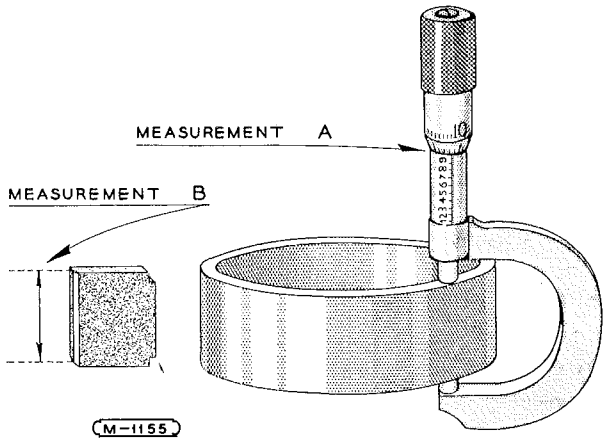


Figure 15
Determining End Clearance of Vane

Check each vane with a micrometer before placing it in the rotor. The length of each vane (measurement "B" in figure 15) should be .0007" to .004" less than the thickness of the cylinder. If any vane has excessive clearance, install a new one. If a new vane is used the clearance should be not less than .0007" the desired clearance being .0015". If a new vane is too long it can be dressed by drawing it lightly across a fine file, being careful to hold it square with the file. Be sure to remove any filings and dust from the vane before installing.

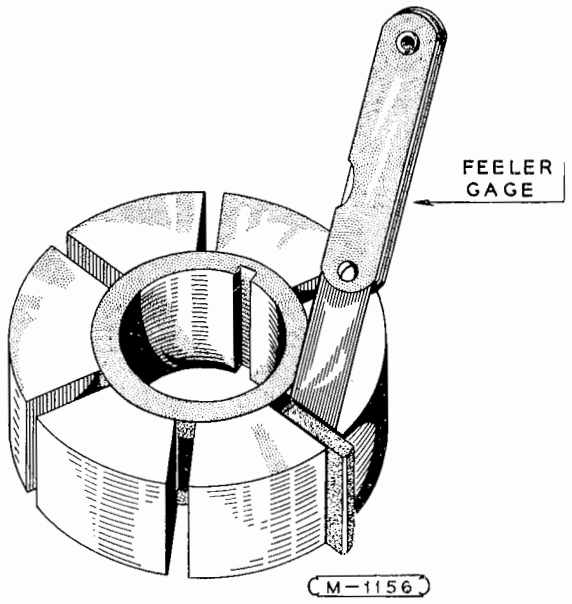


Figure 16
Measuring Slot Clearance of Vane

As each vane is placed in position, check the slot clearance with a feeler gage as shown in figure 16. The slot clearance must be .004" to .007"— that is — it should be possible to insert a .004" feeler, but it should not be possible to insert a feeler which is thicker than .007". If clearance is greater than .007" use a new vane, which must be checked for proper end clearance as described in the preceding paragraph before installing.

After installing the vanes and checking the clearance, apply S.A.E. No. 10 oil liberally over the vanes and rotor. Do not interchange the position of the vanes after checking the slot clearance.

6. Upper End Plate.

See that the upper end plate is absolutely clean and place it in position flat side down. Turn the end plate until it centers with the cylinder and the milled notch in the edge of the plate is exactly facing the dowel pin in the housing.

7. Housing Upper Half.

Install the upper ball bearing in the upper half of the housing. The stamped side of the bearing must face toward the pump rotor. If bearing is a tight fit use No. 11–1815 pressing tool and an arbor press to press it in position. If this tool is not available, place the housing on a steam radiator for a few minutes, keeping the bearing at room temperature. This will expand the housing so that the bearing can be pushed in by hand. The top of the bearing outer race should be approximately flush with the top of the housing.

> ***Note:*** *Some pumps of earlier execution may be found to incorporate a plain non-shielded bearing in the upper support. Under this bearing a thick spacer will be found at a recess cut in the rotor shaft. By eliminating this spacer the later execution air-sealed bearing may be used in earlier execution pumps. If this later execution air-sealed bearing is used and the spacer NOT removed, it will be found that the height of the finger flange will be approximately .020" too high.*

Place the upper felt washer in position on top of the upper end plate. Saturate this felt washer with S.A.E. No. 10 oil. Place the large spring washer in position on top of the upper end plate. Place the upper half of the housing in position, engaging the dowel pins in their correct relation. The oiler in the upper half of the housing should be diametrically opposite the oiler in the lower half.

Secure the upper half with its four screws. Tighten these screws evenly, working from one screw to another until all are tight. This will prevent warping the housing. Do not safety these screws until after testing the pump.

8. Drive Shaft, Timing Ratchets, and Drive Coupling.

Assemble the timing ratchet, drive coupling, and spring on the drive shaft. Make sure the ratchet is right side up because otherwise the teeth will not engage. Insert drive shaft into pump. Place the original shims in position on top of the upper bearing. Install the distributor finger mounting flange, making sure the shims do not prevent the

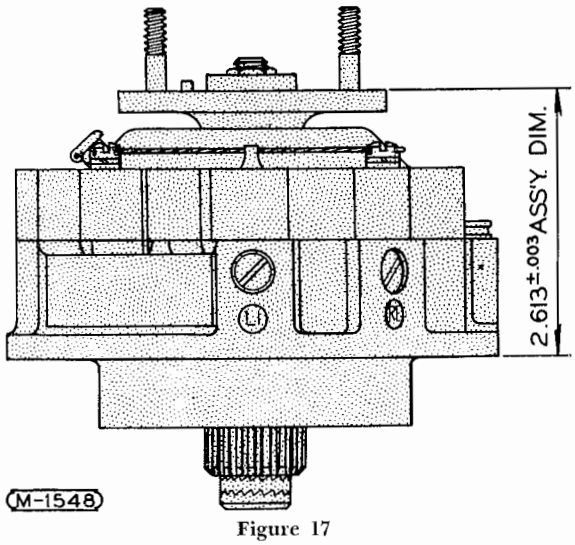


Figure 17
Shimming Dimension for Finger Mounting Flange

flange from seating properly. Secure the flange with its nut. Use No. 11–1239 box wrench to hold the drive coupling and tighten the nut with No. 11–3115 socket wrench. Don't cotter the nut yet.

9. Distributor Finger Mounting Flange Shims.

Although not a required procedure, it will greatly facilitate subsequent installation of the pump on the engine if the shims under the distributor finger mounting flange are adjusted so as to provide a dimension of 2.613″ ± .003″ for the height of the pump flange above the mounting surface at the base of the pump as shown in figure 17. For this reason it is recommended that the practice of assembling the pump to this dimension be adopted in all cases where the equipment is available to make the necessary measurement and adjustment of the flange to this dimension.

E.– Pump Test

A running test of the pump after overhaul can be made on the No. 11–700 test stand, in conjunction with No. 11–1905 pump testing fixture. The test fixture is shown in figure 18. When setting up the equipment, the belt should be run on the large groove of the motor pulley. Also a small pan or cup should be placed under the drain valve "A" to prevent oil running over the bench during operation. The bolts for securing the fixture to the test stand are provided with the fixture.

Close off the drip valve "B" in the oil reservoir of the test fixture, and fill the reservoir about two thirds full of good S.A.E. No. 10 motor oil.

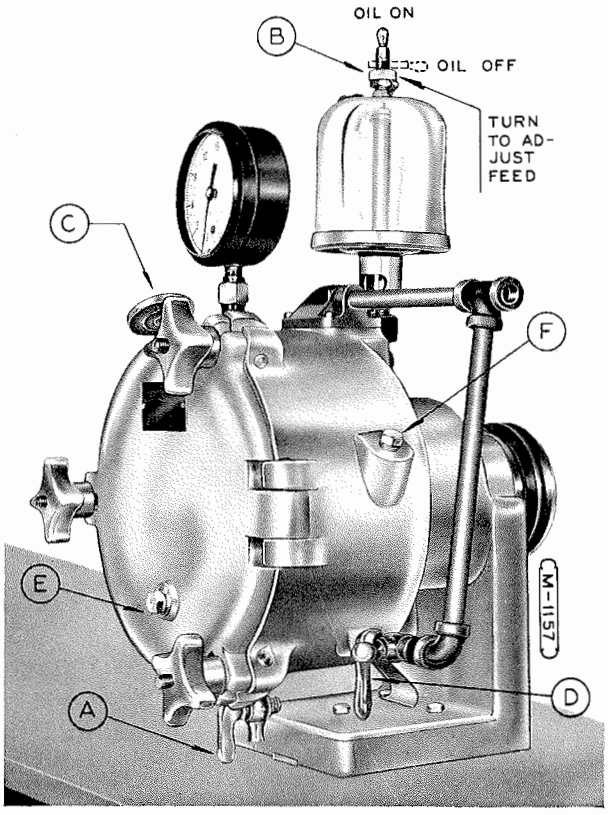


Figure 18
Testing Chamber for Air Pump

Open the door of the test chamber and install the pump to be tested, using the gasket which is provided for the pump seat. The pump intake bushing must be engaged in the corresponding inlet recess in the test chamber. Secure the pump in position with the eight screws provided for this purpose. Be sure to draw the screws up evenly all around. Turn the motor pulley over a few times by hand to make sure all the parts work easily and there is no binding.

Observe the position of the thermometer, "C". As you face the door of the chamber, the thermometer should be on the left side (as shown) for an anticlockwise pump and on the right side for a clockwise pump. You will notice that there is a plugged hole "F" on the right side of the chamber corresponding to the hole in which the thermometer is shown in figure 18. The positions of the thermometer and plug should be interchanged so as to have the thermometer in hole "F" if a clockwise pump is to be tested. This is necessary in order to have the thermometer element close to the pump outlet.

You are now ready to make the test run. Open and adjust the drip valve "B" until the oil runs in a thin stream for a second or two. Then adjust the valve until the oil drips at one drop per second.

Close the drain valve "A" and open the return valve "D". Make sure the orifice in the vent plug "E" in the door is open, and that the interior of the bowl is free of any dirt or foreign material which might plug this vent or any of the valves. Then close the door and lock it shut with the screw knobs provided.

Start the motor and bring the speed up to 1000 rpm. This speed can be read on the test stand tachometer. (Be sure you are running the pump in the right direction.) Run the pump for an hour at this speed with the oil feeding at the rate of one drop per second. Observe the thermometer every 10 minutes during this run. Should the temperature exceed room temperature by more than 50°F. during this run it is an indication of binding or rubbing friction within the pump. Shut the test down and disassemble pump to investigate.

There should be no reading on the pressure gage during this run. If the gage shows a reading, shut down and investigate for possible obstruction in the return air line. Also make sure return valve "D" is open by running a wire through it from inside the test chamber.

At the end of the one hour oil run, open drain valve "A" and close return valve "D". Shut off the oil valve "B". Run pump one hour to exhaust surplus oil. Observe thermometer occasionally to make sure no heating develops in the pump.

At the conclusion of the above run, the pump is ready for the pressure test. Close the oil drain valve "A". When this is done a pressure reading should appear on the gage. Recheck the speed to 1000 rpm. (This speed is used for all tests.)

At 1000 rpm. the pump should develop at least 5 pounds pressure as indicated by the gage. If the pressure is not up to this standard investigate the following:

1. Be sure you are running the pump in the right direction.
2. See that gage fitting, thermometer fitting, thermometer hole plug, return valve "D", and drain valve "A" are tight in position. Apply a little oil to the joints while the pump is operating. If bubbles appear around the joints, there is a leak which must be corrected.
3. Check the gasket in the test chamber cover. If it is broken or deformed, replace it. Make sure the three cover screws are tight when you close the cover.
4. Check the pump seat gasket. If cracked or broken, or otherwise unsatisfactory, use a new gasket.
5. Remove the air inlet casting and check for possible obstruction of the filter element.
6. Inspect the intake port plug in the pump housing to see if it incorporates an .039″ diameter bleed hole. If so, remove the plug incorporating the bleed hole, and replace with a plain undrilled plug.
7. If the above checks do not result in correcting the low pressure, the trouble is in the pump, which must be disassembled and checked for correct assembly. Be sure that the cylinder is correctly installed, and re-check all clearances, as given in the pump reassembly instructions, keeping to the low end of the tolerances wherever this is possible. Always be suspicious of the lower bearing of the pump, when air pressure is low. Try a new lower bearing which is known to have a satisfactory air seal.

Check the vent orifice "E" to make sure it is not plugged. This orifice has an .052″ diameter and should be open at all times. If it is closed by an obstruction, an excessive load will be placed on the pump causing it to overheat.

Run the pump for one hour on the pressure test. Keep a close watch on the thermometer during this run. The permissible temperature depends on the pressure the pump is developing as indicated by the pressure gage. It also depends on the temperature of your workroom. The table below shows the maximum permissible temperature rise above room temperature, for various pressures which may be developed. If the temperature rise is in excess of that given in the table for the pressure read on the gage, binding or excessive friction is present in the pump. Shut down and investigate.

Table of Pressures and Temperatures

Pressure Shown On Gage	Maximum Permissible Temperature Rise Above Room Temperature
5 pounds	47°F.
6 pounds	52°F.
7 pounds	57°F.
8 pounds	62°F.
9 pounds	67°F.
10 pounds	72°F.
11 pounds	77°F.
12 pounds	82°F.
13 pounds	87°F.
14 pounds	92°F.
15 pounds	97°F.

Notice that the above temperatures are in terms of a RISE above room temperature and not the plain thermometer readings. This is necessary because the exhaust air temperature depends on the intake air temperature as well as the heat produced in the pump. For example, suppose you have a temperature of 70° in your workroom. Then if a pump develops 9 pounds pressure on test, the thermometer on the test bowl should not read over (70° + 67 = 137°) 137° at any time during the test run.

Regardless of your test room temperature, do not operate a pump if the thermometer goes above 200°F. This would indicate excessive binding or friction in the pump which must be corrected or the pump will be permanently damaged.

If your overhaul base is located in a particularly high section of the country the altitude will cause slightly lower gage readings to be obtained on the pump test. Therefore, if you are testing pumps at a location more than 2000 feet above sea level you should make allowance for this altitude before rejecting a pump which is on the "border-line" of passing the pressure test.

To make this allowance, add ½ pound pressure to the gage reading for every 2000 feet of altitude at your location. EXAMPLE: Suppose you are testing a pump at some base which is located 2000 feet above sea level, and that pump develops 4¾ pounds pressure on test. According to the specification (5 lbs.), this pump would not pass the test, but due to the altitude of your location it is permissible to add ½ pound to the gage reading. This gives 5¼ pounds total, which enables you to pass the pump as satisfactory.

After a pump has successfully passed the above tests, remove it from the test chamber and put about one half tablespoonful of No. 10 oil in each oiler. Also put about 10 drops of the same oil into the exhaust port, and turn the pump a few revolutions to work this oil around in the pump. Put a piece of adhesive tape over the exhaust and inlet openings to prevent dirt getting into the pump before it is installed on the engine. This completes the overhaul of the pump.

SECTION V

TREATMENT OF HARNESS AND DISTRIBUTORS AT TIME OF ENGINE OVERHAUL

A.– Cleaning

At the time of engine overhaul the harness should be removed from the engine, cleaned, and inspected for mechanical damage and tested electrically.

In removing the harness from the engine, be sure to place protector caps over all the outlets at the time the leads are removed, to prevent entry of dirt or moisture into the lead sockets. Clean the outside of the harness with a cloth dampened in gasoline or kerosene. Do not use active solvents such as thinner or acetone, as they have a tendency to affect the paint. Oil deposits inside the distributors can be removed with a dry cloth – or if the deposit is hard, a little gasoline can be used. Acetone is the best cleaner to use for the dielectric surfaces in the distributor, but keep it away from the paint and do not allow it to run down the electrode bushings where it might work into the filled part of the harness. Rub a thin film of oil on the dielectric parts after cleaning.

Give particular attention to the air passageways in the heads. Remove the air inlets from the distributors and take out all plugs. Then with an air line, blow out all these passages thoroughly. Replace the filter pads in the air inlets when reassembling. See figure 12 for correct location of the plugs and vents on the distributors.

The manifold outlets are coated with DC–4 dielectric sealing compound which is normally a clear white jelly having the appearance of vaseline. The outlets should be inspected to see that this compound is clean. If any outlets are found which have dirt in them, or the compound is discolored, remove the compound and clean out the socket with a cloth dampened in clear unleaded gasoline. Be careful not to damage the spring in the bottom of the socket.

B.– Inspection and Repair

1. Manifold.

Inspect the manifold castings for cracks.

2. Outlet Socket Sleeves.

Inspect the insulating sleeves in the outlet sockets of the manifold. If any of the sleeves are cracked, replacement must be made. However, since special equipment is required for this work, the procedure is covered in a separate section of these instructions.

3. Distributor Electrodes and Bushings.

Inspect the high tension electrode bushings in each distributor. If any cracks are present, the bushing must be replaced as instructed in a later section.

Inspect the electrodes in each distributor. Slight burning of the electrodes is normal, however if any electrode is burned to the extent that you can no longer see any of the original flat surface on the top, the electrode should be replaced. Socket wrench No. 11–2578 and handle No. 11–2934 are used to remove the electrodes. If most of the electrodes need replacement, replace them all. New electrodes must be tightened to a torque value of 18 to 20 pound inches, using No. 11–2578 socket and No. 11–2934 torque measuring handle. The new electrodes must be machined to the correct height after installing. This can best be done with No. 11–1885 milling fixture and height gage tool. (See figure 19.)

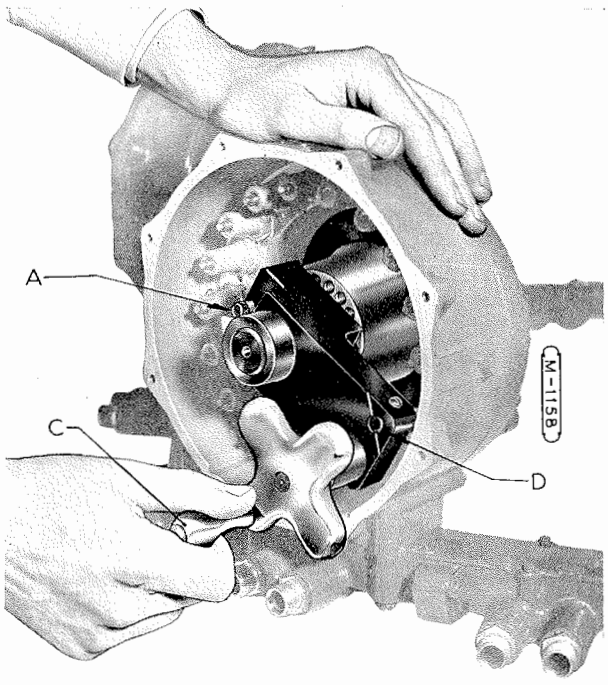


Figure 19
Electrode Milling Fixture in Use

Fasten the tool in position in the distributor housing by means of the screw and large washer which are provided. Be sure that the surface where the tool seats in the bottom of the distributor bowl is clean so that the tool seats perfectly. The dowel on the tool must fit into the air inlet recess in the bowl. Pull out on the locating pin "A" and turn the arm of the tool until the milling cutter is over the electrode to be machined. Then release the locating pin, and be sure it engages the hole in the tool body which will now hold the arm in correct position. Press in on the handle "C" at the same time turning it to the right (clockwise) until the tool stops cutting, at which time the electrode should be of the correct height. This is checked with the flush-pin gage "D" located adjacent to the cutter in the arm. Raise the locating pin and turn the arm until the gage plunger is centered over the electrode to be checked, at which time the locating pin should engage a hole in the tool body. When the gage pin is pressed in against the electrode, the top surface of the gage plunger should set between the two gaging steps around in the surface of the arm.

If the No. 11–1885 tool is not available, the electrodes can be dressed down with a file by a trial and error method. The correct dimensional height is 3.124 ± .006 above the pump seat (dimension "B"

in figure 3). The electrode should be removed from the distributor for filing to avoid possibility of breaking the insulating bushing.

4. Distributor Finger.

Inspect the dielectric parts of the distributor finger for cracks, and make sure all the inserts are tight. Inspect the high tension electrode on the end of the finger. It is advisable to replace this electrode at every overhaul, however an exception can be made to this if the wear is very slight. If the electrode is burned away to a depth of 1/32″ at any place it should be replaced in any case. (See figure 20.)

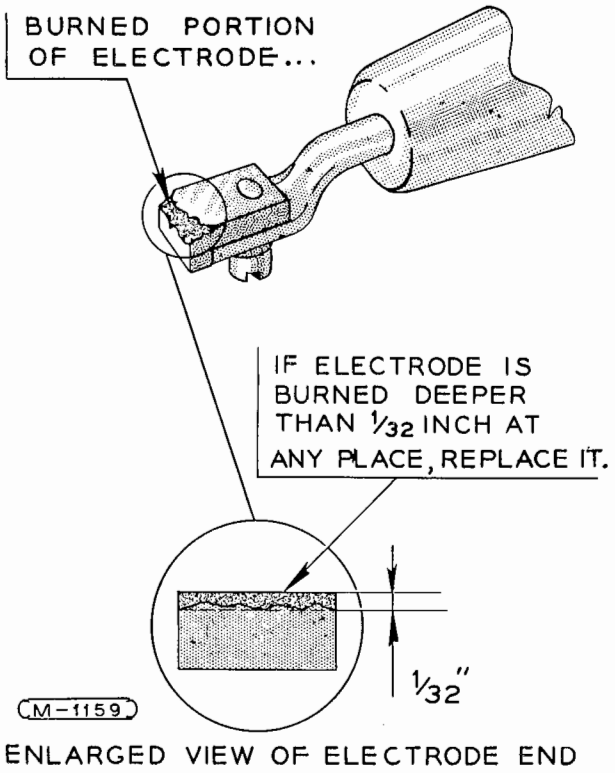

BURNED PORTION OF ELECTRODE...
IF ELECTRODE IS BURNED DEEPER THAN 1/32 INCH AT ANY PLACE, REPLACE IT.
1/32"
M-1159
ENLARGED VIEW OF ELECTRODE END

Figure 20
Checking the Distributor Finger Electrode for Wear

5. Distributor Cover.

Inspect the molded terminal block in the cover for cracks. See that the screws which hold it in place are tight, and that the contact spring in the high tension lead socket is in good condition and properly secured with its screw and washer. Smooth off the high tension electrode with a piece of emery cloth or a small stone. If the electrode is worn excessively replace it with a new one when reassembling.

Inspect the wire braid gasket in the bowl cover. It is important that this be in good condition because any leaks here will result in loss of supercharging pressure. If the gasket is cut or broken at any place use a new one.

If the gasket is defective remove it and clean the sealing groove of all foreign matter by wiping well with a cloth moistened with carbon tetrachloride and scraping with a chisel pointed wooden dowel to remove any accumulated residue from previous operation.

If any portions of the gasket groove are contaminated by a film of corrosion, this must be removed, so that proper contact will be obtained between the part and the conducting gasket. A piece of No. 0000 sand paper folded to fit the groove can be used for this purpose. After cleaning, polish with crocus cloth.

Immediately after cleaning and polishing, apply a thin film of DC–4 compound over the exposed metal. White vasoline or petroleum jelly could be used for this purpose, but the DC–4 compound is preferred because it is more impervious to water and is better able to withstand high temperatures. DO NOT USE yellow or amber vasoline or petroleum jelly as it may contain acid-forming compounds which would attack the metal surfaces.

Pull the gasket through the fingers several times to smooth out any small bends and remove any irregularities. This will cause the metallic braid cover to conform smoothly to the contour of the round neoprene core. Determine the exact length of gasket required by laying it carefully over the contour of the sealing groove holding it in place temporarily by means of paper tape if necessary. Cut the gasket to the proper length plus 1/8 inch surplus for trimming, taking care to maintain the round shape of the gasket as much as possible.

Apply a light coating of DC–4 compound or white vasoline over the entire length of the gasket so as to penetrate the cotton threads. The above application will prevent corrosion of the magnesium parts at the point of contact in the event that the protective anti-corrosion film may have been scraped off in spots.

Cut one end of the gasket at a 45° angle and start laying the gasket in the groove adjacent to a screw hole location. The gasket must be inserted without stretching.

The loose end of the gasket should also be cut at a 45° angle to closely match the end of the braid in the groove, so as to make a neat air-tight joint where they meet.

The gasket must be well seated in the groove by light blows of a fiber or phenolic hammer having an unmutilated face, or it may be formed into position in the groove by means of a flat block of wood. The surface of the gasket when formed into position should be about .015″ above the face of the magneto housing flange. It is considered satisfactory if the gasket is firmly seated in the groove so that the part can be handled and the gasket will not loosen at the joint or fall out of its own weight.

To further improve the shielding and sealing function of the gasket and to assure its proper seating in the groove, it is recommended that the gasket be smoothed out by sliding a smooth object such as the face of a hammer over it in a circular direction while applying pressure.

If any gap shows between the ends, the gasket must be replaced with one giving a perfect joint.

6. Insulating Bowl and Spacer.

Inspect the insulating bowl for cracks. Inspect

the large rubber spacer ring which fits in the groove under the insulating bowl at the bottom of the distributor. If the spacer is badly deformed or deteriorated replace it, otherwise it may not hold the insulating bowl tightly.

7. High Tension Leads.

Wipe off the high tension leads with a clean cloth. Clean the insulators at the spark plug and manifold end with a clean cloth dampened in clear unleaded gasoline. (Avoid an excess.) Inspect the lead conduits for broken braid or severe dents which might develop into electrical failure. Keep the leads away from dirt and moisture. Test leads electrically as instructed under "Electrical Testing."

C.– Electrical Testing

1. Harness Manifold Wiring.

a. Continuity Test.

Always make a continuity test before applying a high voltage test to the harness. To check continuity, use a battery and bulb (or battery and buzzer) circuit tester of about twelve volts. Touch one lead from the circuit tester to an electrode in the distributor head, and the other lead to the contact spring in the manifold outlet socket to which that electrode is connected. The right distributor fires the outlets marked "F" and the left distributor fires those marked "R." The electrodes in each head are connected to the outlets in accordance with the firing order of the cylinders: No. 1 electrode to No. 1 cylinder, No. 2 electrode to No. 12 cylinder, No. 3 electrode to No. 5 cylinder, etc., as shown in figure 21. The No. 1 electrode is plainly marked with a "1" stamped on a boss adjacent to the electrode support bushing.

Should the tester indicate an open circuit on any wire first make sure you are checking the right outlet. Also make sure you have a good connection to the contact spring in the socket well. Try working the test prod around in the well. If there are indications that the spring is not securely attached to the wire in the bottom of the well, or if any springs are broken, replace the outlet socket.

b. High Voltage Test.

The most satisfactory way to determine the electrical condition of a harness is to use a high voltage direct current tester which is capable of measuring the insulation resistance. Many of the harness testers now on the market do not meet this requirement, since they impose an alternating test voltage on the harness, and owing to the capacity of the harness wiring, small leakage current cannot be measured accurately.

There are several good direct current testers on the market at the present time. Among these are the TAKK Tester, manufactured by TAKK Corp., 26 West Market Street, Newark, Ohio; the Delco Aviation Ignition Tester, manufactured by Delco Radio Division, General Motors Corp., Kokomo, Indiana; and the B-G Direct Current Testers, manufactured by B-G Corp., 136 W. 52nd St., New York, N. Y.

The high voltage test is conducted by connecting the ground lead of the tester to the harness manifold, and the high tension lead to a distributor block electrode. The tester is then turned on and the voltage brought up to 10,000 volts. A meter is provided on the tester which shows the amount of current leaking through the harness insulation. The amount of leakage is an indication of the general condition of the wire under test. A good wire will have very low leakage while a bad one will have excessive leakage. Instructions are provided on the tester instruction sheet for converting the leakage reading into an insulation resistance value, and if the insulation resistance as calculated in this manner is less than 100 megohms on any of the above tests, it indicates a weakened condition of the insulation which should be corrected before placing the harness in service.

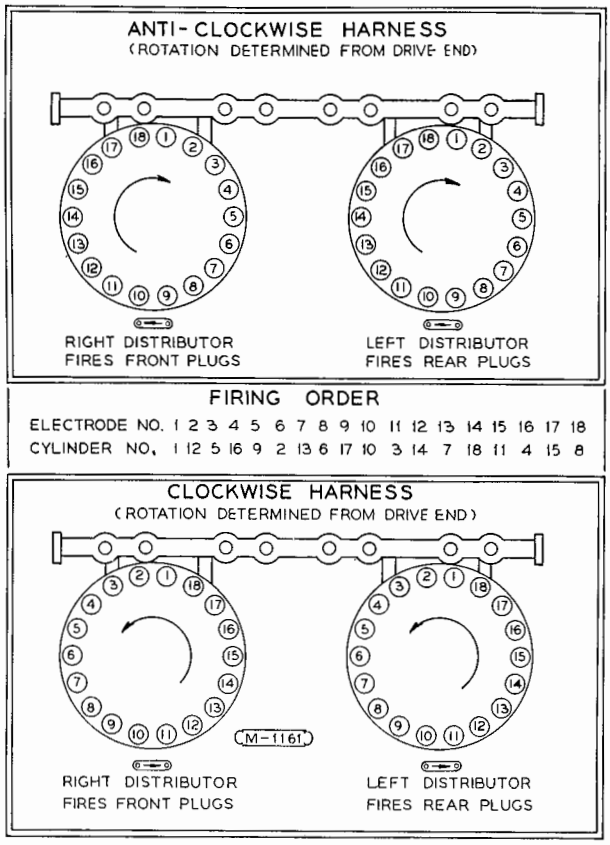

ANTI-CLOCKWISE HARNESS
(ROTATION DETERMINED FROM DRIVE END)
RIGHT DISTRIBUTOR
FIRES FRONT PLUGS
LEFT DISTRIBUTOR
FIRES REAR PLUGS
FIRING ORDER
ELECTRODE NO. 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18
CYLINDER NO. 1 12 5 16 9 2 13 6 17 10 3 14 7 18 11 4 15 8
CLOCKWISE HARNESS
(ROTATION DETERMINED FROM DRIVE END)
M-1161
RIGHT DISTRIBUTOR
FIRES FRONT PLUGS
LEFT DISTRIBUTOR
FIRES REAR PLUGS

Figure 21

Chart to Show Numbering of Distributor Head Electrodes

The test should be conducted between each wire and the harness manifold by connecting the tester in sequence to each electrode in each head, and conducting the test as above each time.

Do not keep the tester turned on any longer than is necessary when making a test. This applies especially to a wire which may show a rather high leakage, in which case you should SHUT THE TESTER OFF AS QUICKLY AS POSSIBLE.

If a high voltage direct current machine is not available, the test can be conducted with such test equipment as may be at hand. However do not test with more than 10,000 volts peak voltage. This is the equivalent of 7100 volts for A.C. testers, which read R.M.S. voltages.

Home made harness testers should be used only with caution. Do not use a tester which does not have an accurate means of indicating and controlling the output voltage. If this is accomplished by a shunt spark gap, calibrate the gap to 10,000 peak volts before you use the machine. Remember that you can damage the harness very quickly with an improperly designed tester.

2. Spark Plug and High Tension Leads.

The spark plugs and high tension leads should be subjected to the same continuity and high voltage tests as the ignition wiring. Be sure the insulators are clean and dry before applying a high voltage test.

D.– Heating Harness to Remove Moisture

In cases where a manifold wire shows low insulation resistance on test, it is sometimes possible to correct this fault by heating the harness for a period of time. If the fault is due to moisture alone, and no burning of the insulation has taken place, the harness can be restored to serviceable condition.

A thermostatically controlled electric oven provides the best means of heating the harness. The control feature is most important because temperatures in excess of 160° F. are harmful to the manifold. After the harness has been cleaned as completely as possible, remove all outlet caps and place it in the oven for 8 hours at a temperature of 130° ± 10° F. Allow the harness to cool in a dry place. Then repeat the high voltage electrical test. If the insulation resistance reading has improved but is not yet satisfactory, repeat heating cycle. If heating does not improve the insulation resistance it usually means that the insulation is carbon tracked and the manifold must be rewired at the factory.

SECTION VI
SPECIAL REPAIR PROCEDURES

A.— Replacing the Spark Plug Lead Outlet Sockets

In general it is recommended that a socket be replaced when either of the following conditions exist:

(1) If the leakage of the wire feeding the socket exceeds 50 microamperes when checked with a direct current tester set at 10,000 volts and attempts to correct the leakage by cleaning up the distributor block (on fourteen cylinder harnesses) or the electrode insulating support (in the eighteen cylinder harness) have failed to reduce the leakage to 50 microamperes or less.

(2) If the insulating sleeve in the socket is cracked, broken, or carbon tracked when inspected visually.

It should be noted that these instructions apply only to harnesses which are equipped with the "waterproof" type of outlets. Early harnesses which do not incorporate the waterproof outlets, cannot be repaired by the procedure described in these instructions.

Before starting the work of replacing the sockets, the harness should be thoroughly cleaned externally. This is done to remove all foreign material which might otherwise get into the socket while it is disassembled. It is assumed that all the manifold sockets have been cleaned and that the harness has been tested electrically and visually inspected to determine which sockets require replacement. If this has not been done, the outlet sockets should be cleaned by first removing all excess DC–4 compound, and then wiping out the socket with a small swab or a piece of No. 11–2724 felt rod. Dip the swab or felt rod in acetone, then push into the outlet, at the same time turning clockwise, so that the spring in the bottom of the socket will not be damaged. After cleaning the sockets, allow a few minutes for the acetone to dry before testing electrically.

Because the original sleeve and bushing assemblies are pinned in position, they cannot be unscrewed without first removing the locking pins.

To remove the locking pins, make hacksaw cuts in the hexagon section of the bushing just back of the pins as shown in figure 22. To avoid cutting into the manifold it is a good idea to make the hacksaw cut only part way through the bushing flange. Then the piece of bushing can be broken away with a small chisel as shown in figure 23, and lifted off the pin. The pin may now be pulled with pliers.

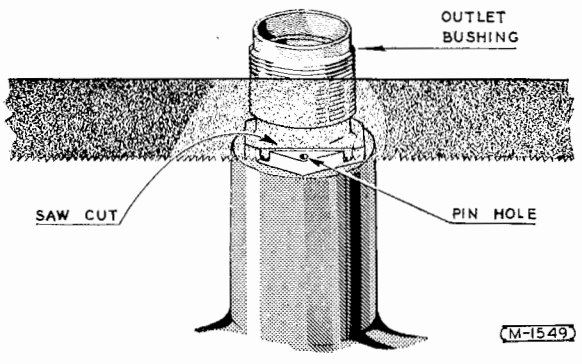


Figure 22
Location of Saw Cut in Bushing Flange

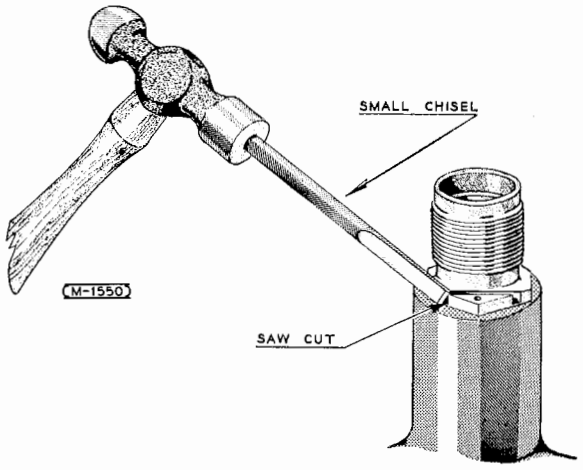


Figure 23
Breaking Away the Pinned Section of Bushing

Drill a $^1/_{16}$" diameter hole through the manifold outlet on the back, (the side away from the manifold cover) of the outlet and $^7/_{16}$ inch from the end of the outlet. Figure 24 shows the location of this hole. The hole will serve as a vent for the insulating compound which will be used to fill the space around the new sleeve when the latter is placed in position. The hole is drilled at this time so that chips will be prevented from getting into the cavity behind the sleeve, after the latter is removed.

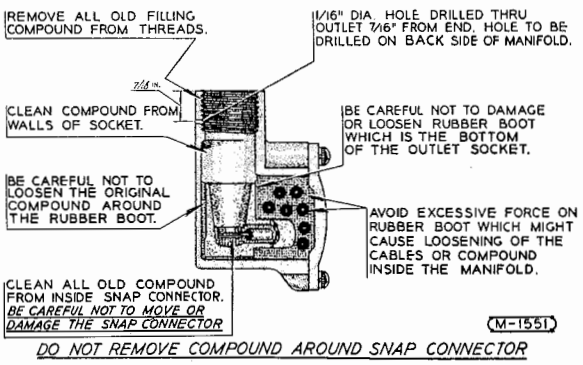

REMOVE ALL OLD FILLING COMPOUND FROM THREADS.
1/16" DIA. HOLE DRILLED THRU OUTLET 7/16" FROM END. HOLE TO BE DRILLED ON BACK SIDE OF MANIFOLD.
7/16 in.
CLEAN COMPOUND FROM WALLS OF SOCKET.
BE CAREFUL NOT TO DAMAGE OR LOOSEN RUBBER BOOT WHICH IS THE BOTTOM OF THE OUTLET SOCKET.
BE CAREFUL NOT TO LOOSEN THE ORIGINAL COMPOUND AROUND THE RUBBER BOOT.
AVOID EXCESSIVE FORCE ON RUBBER BOOT WHICH MIGHT CAUSE LOOSENING OF THE CABLES OR COMPOUND INSIDE THE MANIFOLD.
CLEAN ALL OLD COMPOUND FROM INSIDE SNAP CONNECTOR. BE CAREFUL NOT TO MOVE OR DAMAGE THE SNAP CONNECTOR
M-1551
DO NOT REMOVE COMPOUND AROUND SNAP CONNECTOR

Figure 24
Sectioned View of Outlet with Sleeve and Bushing Removed

Place the manifold in an oven at 160° F. for about $^1/_2$ hour or until it is thoroughly heated throughout. Remove the manifold from the oven, and before it cools unscrew the outlet socket bushing in the following manner:

1. Using No. 11–1687 torque measuring handle or equivalent and the proper hexagon socket, turn the bushing very slightly clockwise, then anticlockwise several times to loosen it. Do not apply more than 50 foot pounds of torque to the bushing.
2. After bushing has been loosened by working it back and forth several times, it may be unscrewed from the manifold. Take care to work the bushing back and forth while unscrewing it.

Usually it will be found that the insulating sleeve remains in the manifold, although it may occasionally come out with the bushing. To remove the sleeve you can make up a small puller, using the bushing which was just removed. Figure 25 shows the details of the sleeve puller. To make it, chuck the old bushing in a lathe and turn down until the threads are entirely removed from the larger end (the end which was screwed into the manifold). After doing this, the end of the bushing must be turned off until the length from the bottom of the flange is $\frac{3}{8}'' \pm \frac{1}{64}''$. Be sure to remove the corprene packing washer from inside the bushing. Provide a handle which may be made by welding two pieces of $\frac{1}{4}$ inch rod as shown in figure 25, to a discarded outlet cap or any other part which will engage the thread remaining on the upper end of the bushing. Assemble by screwing the handle and bushing together tightly, and the puller is ready for use.

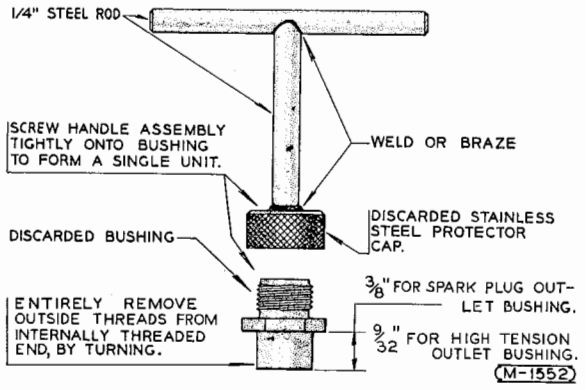

1/4" STEEL ROD
SCREW HANDLE ASSEMBLY TIGHTLY ONTO BUSHING TO FORM A SINGLE UNIT.
WELD OR BRAZE
DISCARDED STAINLESS STEEL PROTECTOR CAP.
DISCARDED BUSHING
3/8" FOR SPARK PLUG OUTLET BUSHING.
ENTIRELY REMOVE OUTSIDE THREADS FROM INTERNALLY THREADED END, BY TURNING.
9/32" FOR HIGH TENSION OUTLET BUSHING.
M-1552

Figure 25
Puller for Removing Sleeves

Apply a little grease to the internal threads of the puller. Then start the puller into the outlet and turn to the right until the internal threads of the puller engage the external threads of the insulating sleeve which is to be removed from the manifold.

> ***Note:*** *Be sure the harness is thoroughly warm before trying to pull the sleeve. If it has cooled noticeably, reheat to 160° F. in the oven before pulling the sleeve.*

Now, using a steady even pressure, continue to turn the handle to the right until it turns freely, at which time the puller and sleeve can be removed by pulling straight upward on the puller handle.

After removing the old sleeve and bushing assembly, the socket recess must be cleaned thoroughly. For this operation a pair of small tools as shown in figure 26 will be useful. The first is of round fiber or hardwood, about $\frac{1}{4}''$ diameter, shaped to a chisel point as shown. The corners of the chisel point should be rounded. The second tool is two-ended, made of $\frac{1}{8}''$ steel rod with a piece of rubber tubing slipped over it for a hand grip. One end is formed to the shape of a small paddle while the other end is fashioned into a small spoon. The edges of the paddle should be fairly sharp to cut the old compound in the socket recess. Further details of this tool are shown in the figure.

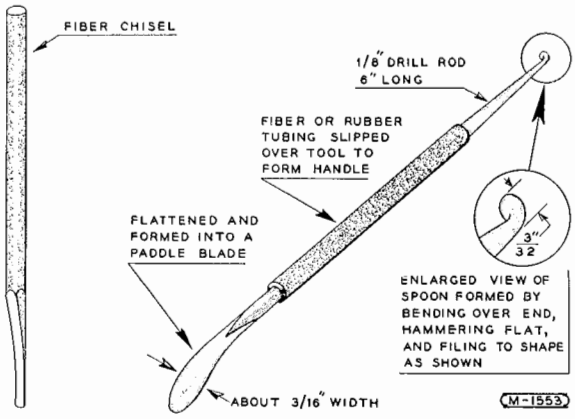

FIBER CHISEL
1/8" DRILL ROD 6" LONG
FIBER OR RUBBER TUBING SLIPPED OVER TOOL TO FORM HANDLE
FLATTENED AND FORMED INTO A PADDLE BLADE
3/32"
ENLARGED VIEW OF SPOON FORMED BY BENDING OVER END, HAMMERING FLAT, AND FILING TO SHAPE AS SHOWN
ABOUT 3/16" WIDTH
M-1553

Figure 26
Tools for Cleaning and Filling the Outlet Recess

Details of the cleaning operation in the outlet recess are shown in figure 24 which is a sectioned view of the recess. Remove all the old compound from the manifold threads, and from the upper (metal) walls of the recess. The small spoon is convenient for cleaning the threads and its edge should be shaped to fit the thread groove for this purpose. Be careful not to damage the threads when using the tool in this manner. It is especially important that no scrapings be removed from any of the metal parts, because these chips might find their way down into the bottom of the recess and cause a short circuit or excessive leakage. Clean all compound from the interior of the rubber "boot" in the bottom of the recess. Be careful not to cut or loosen the rubber while doing this. The fiber chisel is recommended for this work.

Using the small spoon on the end of the metal tool, clean up the interior of the snap fastener connection at the bottom of the recess. DO NOT CUT, BEND, OR LOOSEN THE SNAP FASTENER CONNECTION. It is only necessary to remove all old compound so that a good electrical contact will be made at this point when the new sleeve and bushing assembly is screwed into position. You will find that the compound can be easily removed by a gentle scraping without damage to the metal surfaces of the connector.

Using an air line which has provision for removing the moisture from the air, blow out all loose particles of compound from the recess. Make sure that the hole you drilled in the side of the outlet is open.

Place the manifold in an oven at 160° F. for one

hour. Also place a small container of Scintilla No. 47 Compound in the oven together with the manifold.

Thoroughly clean the external dielectric surfaces of the new sleeve and bushing assembly with acetone. Then wipe with an absolutely clean dry cloth, and place the sleeve and bushing assembly in the oven with the other parts. DO NOT TOUCH THE EXTERNAL DIELECTRIC SURFACES OF THE SLEEVE WITH YOUR FINGERS AFTER THIS CLEANING. (See figure 27) The assembly may be handled by grasping the threaded metal bushing.

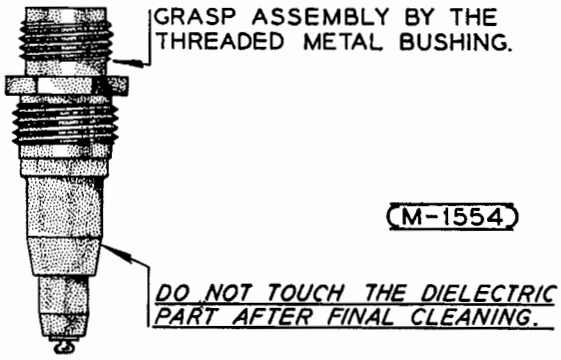


Figure 27
Bushing and Sleeve Assembly

Remove the manifold and container of compound from the oven. Clamp the manifold in a suitable vise so the open outlet is in a vertical position. This is necessary in order to have the compound drop from the tool directly onto the snap fastener and not run down the side of the recess wall. Heat the small two-ended tool until it is thoroughly warm (160°-170° F.). Take up a small amount of No. 47 Compound on the spoon of the two-ended tool and place it directly into the bottom of the open socket recess in contact with the snap fastener. A little practice will enable you to judge the proper amount of compound so that the tool can be lowered into the outlet just at the instant a drop of compound falls from the end. This procedure is used to prevent an air bubble being trapped under the compound, as might be the case if a large amount of compound were placed in the recess at one time.

> ***Note:*** *To do this properly, the manifold, compound and tool must be thoroughly heated, otherwise the compound will not drop from the end of the tool.*

After the first drop has been placed in the bottom of the recess, slowly add further compound until the recess is filled just to the bottom of the outlet threads. Be sure the compound is added slowly so that no air will be trapped in the outlet. If necessary, provide two containers for compound, keeping one in the oven while the other is used, so that the compound is always thoroughly heated. This will improve the flow characteristics of the compound, thus decreasing the chance of leaving any air pockets in the fill.

Remove the new sleeve and bushing assembly from the oven, and by means of the small paddle shaped tool apply a thin film of No. 47 Compound all over the dielectric surface, and in the lower threads of the metal bushing.

Start the sleeve and bushing assembly into the manifold recess. This must be done VERY SLOWLY AND CAREFULLY, allowing compound to escape from the vent hole as necessary to permit entry of the sleeve into the recess. Do not try to hurry this phase of the work, otherwise hydraulic pressure will be set up in the recess, causing damage to the manifold filling or the sleeve itself.

When the assembly is fully seated, tighten to a torque value of 25 POUND feet.

Allow about half an hour for all surplus compound to work out of the vent hole which was drilled in the socket. Then wipe off all the compound and plug the hole with a No. 10–17712 drive screw or equivalent. (See figure 28).

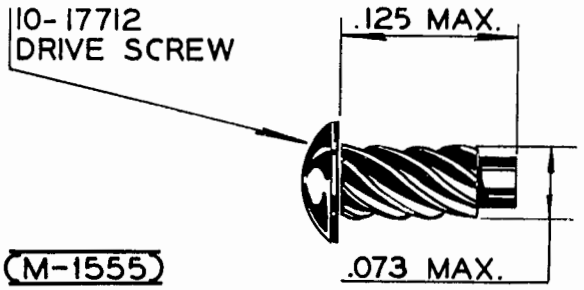


Figure 28
Dimensions of Drive Screw

To pin the new bushing in position drill two .040″ holes into the manifold, locating through the holes in the hex of the new bushing. These holes should be ⅜″ deep from the top of the bushing flange. After drilling, insert a No. 10–1196 pin in each hole, seat in position with a pin punch, and stake or peen over the hole in the bushing flange to prevent the pin from coming out.

Examine the interior of the new sleeve and remove any chips or foreign particles. Check the continuity of the repaired socket, using a 12 Volt buzzer or light test set. Clean the inside of the socket with acetone and dry thoroughly. Test all wires with 10,000 volts D.C. in the usual manner. The leakage must not exceed 50 microamperes. This completes the repair of the outlet socket.

B. – Replacement of Distributor Electrode Support Bushings.

The operations specified in these instructions may be performed on any Bendix-Scintilla 18 cylinder cast, filled ignition harness. Although there are minor differences in the insulating support bushings on early execution harnesses, these differences will not affect the procedure to any practical extent.

The usual reason for replacing support bushings

is breakage or cracking. However it may be desirable in some cases to replace for electrical reasons as, for example, the following:

1. If the leakage is more than 50 microamperes on the wire connected to the bushing, and cleaning of the manifold outlet has failed to correct or reduce this leakage.
2. If the bushing is carbon tracked.

For these reasons an electrical test should be conducted before starting the job of replacing a bushing, so that all suspected bushings can be replaced at the same time. Make the test at 10,000 volts with the D.C. tester. On any wires showing more than 50 microamperes leakage, clean both the outlet socket and the support bushing with acetone and repeat the test. If leakage is still too high, replace support bushing before replacing the outlet socket.

Before starting to change a support bushing, make sure the harness is thoroughly clean and that protector caps have been installed on all the harness outlets. Using a small amount of carbon tetrachloride, unleaded gasoline or acetone, on a clean cloth, carefully wipe out the inside of the distributor bowl, removing all oil, dust and moisture. This is necessary for two reasons:

1. To eliminate the presence of dirt and foreign material which might otherwise get into the cavity after the defective bushing is removed.
2. To eliminate an oily film on the inner walls of the distributor compartment, because such a film might catch and hold small chips or particles resulting from the operation of removing the old bushing. These particles might later work free and enter the ventilating passages of the distributor, obstructing the drilled orifices and preventing proper ventilation.

Figure 29 is a sectional drawing of the complete insulating support, showing the manner in which the cable is secured inside it. To remove the bushing, first remove the electrode and lock washer. No. 11–2578 socket wrench and No. 11–2934 handle are used for this purpose. Using a $^{5}/_{64}$" Allen wrench, inserted into the hole from which the electrode was removed, unscrew the socket head screw inside the support bushing. This screw locks the cable in position.

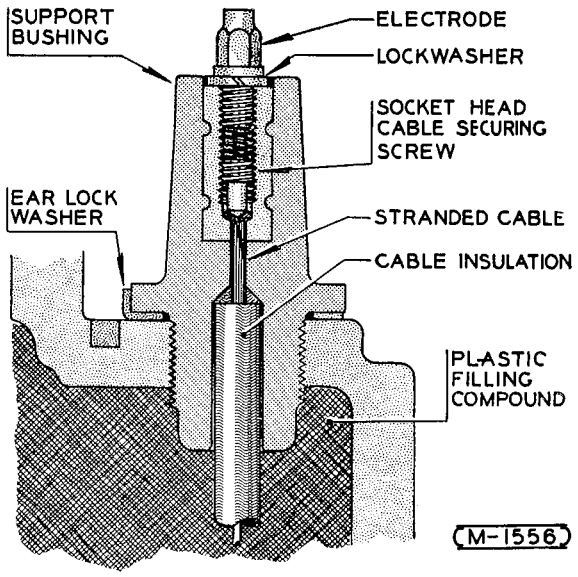


Figure 29
Cross-Sectioned View of Electrode Support Bushing in Eighteen Cylinder Harness

Bend back the ear lock washer which is under the hexagon flange of the bushing. Then place the manifold in an oven at 160° F. for one half hour or until the assembly is heated throughout. Immediately upon removal from the oven, unscrew the bushing, using No. 11–2153 socket and No. 11–1687 handle. Be careful in applying pressure to the wrench when doing this, as the bushing is easily broken. Apply a steadily increasing pressure until the bushing starts. Then work the wrench back and forth to loosen the bushing as much as possible, before actually turning it out.

If the hexagon flange breaks when you are removing the bushing, or if it should be already broken off when you get the job, the piece of bushing left in the distributor casting can be removed as follows:

1. Make up a special tool as shown in figure 30, having two pins which can be engaged in holes which are to be drilled in the bushing.

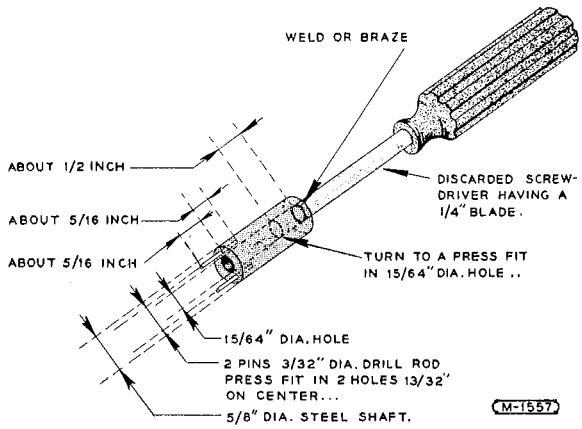

WELD OR BRAZE
ABOUT 1/2 INCH
ABOUT 5/16 INCH
ABOUT 5/16 INCH
DISCARDED SCREW-DRIVER HAVING A 1/4" BLADE.
TURN TO A PRESS FIT IN 15/64" DIA. HOLE ..
15/64" DIA. HOLE
2 PINS 3/32" DIA. DRILL ROD PRESS FIT IN 2 HOLES 13/32" ON CENTER...
5/8" DIA. STEEL SHAFT.
M-1557

Figure 30
Tool for Removing Broken Support Bushings

2. Drill two $^{3}/_{32}$" holes $^{13}/_{32}$" apart in the broken piece, insert the pins of the tool into them and unscrew the piece.

   Note: *The harness must be thoroughly warmed to 160° F. before trying to unscrew the broken piece of bushing.*

After removing the bushing, straighten out the strands of the cable, and twist them together so that they can be entered in the new bushing. Remove all the old sealing compound from the wire, down to the bottom of the recess.

Important: *Be sure you remove* ***only*** *the sealing or filling compound from the wire — NOT THE INSULATION WHICH COVERS THE WIRE STRANDS.*

Clean out all loose crumbs of plastic-filling com-

pound from the bushing cavity. Do not disturb or loosen any other compound in the cavity. Before installing the new bushing, carefully inspect the insulation of the wire, in the bushing cavity. If the insulation is cracked or broken, reject the harness, as repair would not be practical. Also check the wire for concealed cracks by conducting an electrical test. Place a small sleeve of insulating material over the wire so that flashover cannot occur from the bare end of the conductor. (A piece of glass or heavy rubber tube will do.) Then apply 12,000 volts to the other end of the wire, by inserting a good spark plug lead in the correct socket and connecting a D.C. Tester between the lead terminal and ground. If flashover occurs in the bottom of the bushing cavity, the wire insulation is damaged, and a safe repair is doubtful. Return the harness to the factory. If no flashover occurs, proceed with the installation of the new bushing.

Place the manifold in an oven at 160° F. for one hour. Also place a small container of Scintilla No. 47 Compound in the oven with the manifold.

Wash all parts of the new bushing in acetone. Then wipe with an absolutely clean dry cloth and place in the oven with the other parts. DO NOT TOUCH THE LOWER (THREADED) PART OF THE BUSHING WITH YOUR FINGERS AFTER THIS CLEANING. The bushing may be handled by the upper (tapered) section.

Remove the manifold and container of compound from the oven. Apply a very thin film of No. 47 Compound to the inner surfaces of the bushing cavity and over the wire insulation.

Remove the new bushing from the oven and apply a thin film of compound to the lower section and the threads. Make sure that there is no cable locking screw in the new bushing. Also make sure the strands of the wire in the manifold are twisted together compactly. Then carefully insert the new bushing into position, entering the cable at the same time. Turn the bushing into position slowly to allow the excess compound to escape at the top. Do not try to hurry this phase of the work, otherwise hydraulic pressure will be set up in the recess and damage may be done.

When the bushing is thoroughly seated, tighten to a torque value of 30 to 40 pound-inches, and lock by bending up the ear lock washer.

Using the small spoon shaped tool remove the compound from the electrode hole in the new bushing. Remove as much compound as can be reached. Then insert the cable locking screw and tighten with the Allen wrench.

Install a new electrode and lock washer. Check the height of the electrode after tightening to a torque value of 18 to 20 pound-inches. This may be done by laying a straightedge across the two electrodes on each side of the one just replaced, and filing the new electrode so that it just touches the straightedge.

Thoroughly clean the inside of the distributor to remove all traces of compound, chips, or filings. Check the continuity of the wire connected to the repaired support using a 12 volt test set. Wipe off all the insulating support bushings with acetone. Test all wires with 10,000 volts D.C. in the usual manner. The leakage must not exceed 50 microamperes. This completes the repair of the distributor electrode support bushing.

C. – Supplement Covering Removal of Outlet Socket Bushings From the Zinc-Coated Manifolds.

If it is desired to remove an outlet socket sleeve from one of the late execution manifolds incorporating a zinc coating, the following procedure must be followed in order to remove the zinc coating from the outlet before trying to remove the bushing.

Prepare a hacksaw blade as shown in figure 31 by grinding away the back of the blade to a width of about ¼ inch, for a length of about 2 inches from the end. Tape the other end for use as a handle.

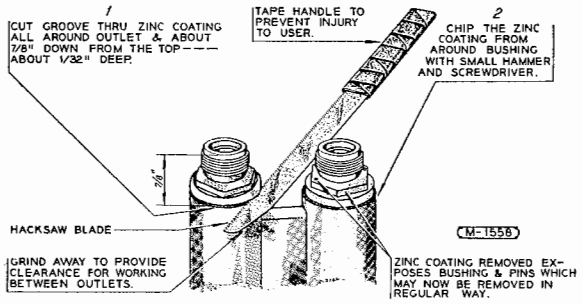

1
CUT GROOVE THRU ZINC COATING ALL AROUND OUTLET & ABOUT 7/8" DOWN FROM THE TOP— — — ABOUT 1/32" DEEP.
TAPE HANDLE TO PREVENT INJURY TO USER.
2
CHIP THE ZINC COATING FROM AROUND BUSHING WITH SMALL HAMMER AND SCREWDRIVER.
7/8"
HACKSAW BLADE
M-1556
GRIND AWAY TO PROVIDE CLEARANCE FOR WORKING BETWEEN OUTLETS.
ZINC COATING REMOVED EXPOSES BUSHING & PINS WHICH MAY NOW BE REMOVED IN REGULAR WAY.

Figure 31
Method of Removing Zinc Coating from Outlets

Cut a groove through the zinc coating all the way around the outlet, about 7/8 inch down from the end of the bushing as shown at (1) in figure 31. After a little practice many mechanics will be able to determine by the sound of the saw when it has penetrated through the zinc coating. If this is not possible, a groove about $^1/_{32}$ inch deep will be satisfactory.

After cutting the groove all the way around the outlet, take a small hammer and a screw driver and chip away the zinc coating from around the hexagon flange of the bushing. For this operation a screw driver or square ended chisel is better than a regular chisel, the object of the work being to break the zinc coating away, rather than cut through it.

After the zinc coating has been chipped away as shown at (2) in figure 31, the bushing may be removed in the regular manner.

After the new bushing and sleeve assembly has been installed, thoroughly clean the metal surface of the manifold casting and the edge of the zinc coating to remove all traces of the No. 47 compound which was forced out. This may be cleaned with carbon tetrachloride, unleaded gasoline, lacquer thinner, or benzine. It is very important that the surface be absolutely clean before applying a protective coating of paint.

When the surface is thoroughly clean, apply a coat of zinc chromate primer, (AN-TT-P-656) thinned to a proportion of one part primer and one

part lacquer thinner or naphtha. Apply the primer with a small brush over all exposed metal surfaces of the outlet, except the actual threads of the bushing. When the primer coat has dried, apply two coats of gray four hour enamel, making sure to apply a substantial amount of paint over the edge of the zinc coating and around the edge of the hexagon flange of the bushing.

SECTION VII

LIST OF RECOMMENDED TOOLS FOR SERVICING THE R–2800 DISTRIBUTOR, SUPERCHARGING PUMP, AND CAST HARNESS

Tool No.	*Name*	*Application*
11–700	Magneto Test Stand	Used with the 11–1905 Testing Chamber for testing supercharging pumps.
11–1058	Staking Tool	To stake retainer plate screws.
11–1239	Box Wrench (17 tooth spline)	To hold drive gear when tightening or loosening finger flange securing nut on the supercharging pump.
11–1395	Socket Wrench	To tighten or remove distributor finger on finger flange.
11–1687	Torque Wrench	Used in removing and replacing outlet bushings.
11–1757	Flowmeter	To check leakage of distributors and magnetos prepared for supercharging.
11–1815	Pressing Tool	To remove or install ball bearings.
11–1867	Special Pliers	To remove or install center high tension electrode.
11–1885	Milling Fixture and Height Gage	To mill off and gage height of distributor electrodes.
11–1899	Feeler Gage	To measure the clearance between the finger and distributor head electrode.
11–1905	Pressure Pump Test Chamber	For use with the 11–700 test stand to make a running test of supercharging pump.
11–2153	Socket	To remove outlet bushings.
11–2578	Socket Wrench	Used with 11–2934 torque wrench to remove or replace distributor electrodes.
11–2724	Felt Rod	For cleaning the outlet bushings.
11–2934	Torque Wrench	To remove and replace distributor electrodes.
11–3116	Removing or Installing Tool	To remove or install the rubber bushing in the air inlet or outlet of the supercharging pump.
11–3120	Gage	To check shimming of distributor finger and center electrode.

SERVICE INSTRUCTIONS

BENDIX-SCINTILLA

LOW TENSION --- HIGH ALTITUDE

IGNITION SYSTEM

Used on

PRATT & WHITNEY

AIRCRAFT ENGINES

Model R-2800-C

SCINTILLA MAGNETO DIVISION
BENDIX AVIATION CORPORATION
SIDNEY, NEW YORK, U. S. A.

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FORM L-242-1

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SECTION I

DESCRIPTION

1. GENERAL

a. The complete low-tension, high-altitude ignition system for Pratt and Whitney R–2800 engines consists of a magneto, a harness with nine detachable primary leads, two distributors, eighteen double high-tension coils and thirty-six high-tension leads. As shown in Figure 1, the appearance of these parts on the engine does not differ radically from that of a conventional high-tension system. However, the low-tension system is electrically quite different from the high-tension system.

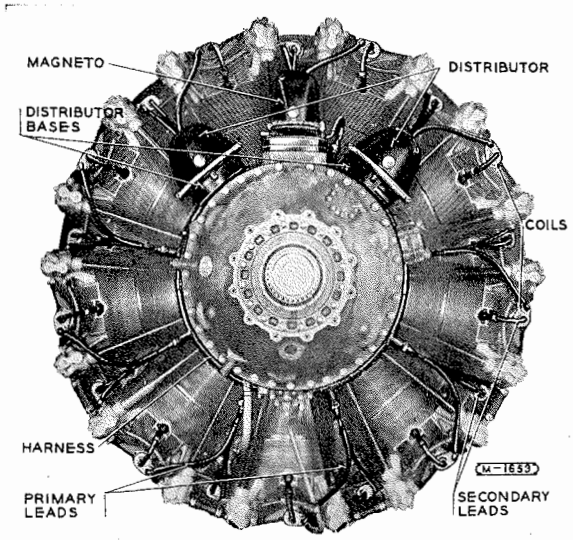


Figure 1
View of Complete Low Tension System Installed on P & W R–2800 Engine

b. Figure 2 illustrates the basic electrical difference between high-tension and low-tension ignition systems. The high tension system generates high voltage at the magneto, and then transmits this high voltage through the distributors to the spark plugs.

c. The high altitude, or low-tension system, on the other hand, generates only low voltage current at the magneto. This low voltage current is transmitted through the distributors to the secondary transformer coils, which are located near the cylinders. There the current is transformed to the high voltage needed at the spark plug and delivered through a very short lead to the plug itself. This system practically eliminates the possibility of flashover at the distributor or around the harness, because only low voltage current flows in these parts of the system. Electrical losses are reduced also, since the path of the high voltage current is short.

2. DETAILED DESCRIPTION

a. The Type DLN–10 Magneto. (See Figure 3.)

(1) The type DLN–10 magneto used on R–2800 low-tension systems is of double-tandem four-pole-magnet design, and is of anti-clockwise rotation. Two four pole magnets are mounted on the magnet shaft, with the poles of one magnet staggered 45° from those of the other. Each magnet operates in conjunction with two pairs of pole shoes, one pair on either side of the magnet. A coil is mounted upon each pair of pole shoes, making four coils in all. Each coil consists of a single primary winding of relatively few turns of heavy wire. There are no secondary windings. One end of each coil winding is grounded to the magneto housing. The other end is connected through a four-pin electrical connector into the harness.

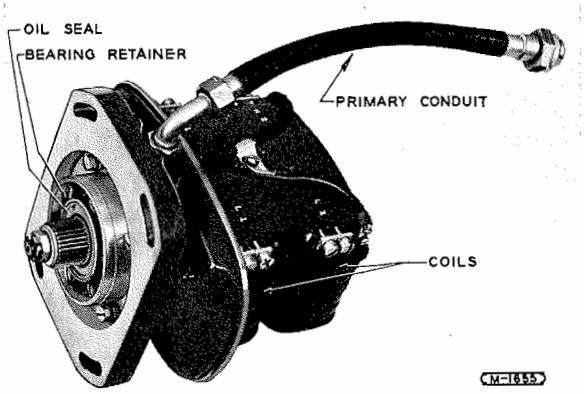


Figure 3
The Type DLN–10 Magneto with Cover Removed

(2) The magneto is mounted on the front of the engine by means of a standard four-bolt flange. It is driven at 1-1/8 engine crankshaft speed. The magnet shaft is supported on two ball bearings. The housing and cover are of cast-magnesium alloy and are precision-machined and secured together with a special clamping ring to provide adequate radio-shielding. A timing plunger is provided which, when depressed, engages a notch cut in the magnet shaft. This facilitates setting of the magneto in its exact firing position, when timing to the engine.

b. The Harness Assembly and Primary Leads

(1) The harness assembly consists of a tubular metal manifold to which are permanently attached the bases for the two distributors. The manifold carries nine primary lead outlets, one magneto connection and one switch connection. (See Figure 4.) All the outlet connections are four-pin plug-in electrical connectors.

(2) Within the manifold are 44 primary (low-tension) wires. Four wires run from the magneto connector (two to each of the two distributors). Four wires run from the switch connector (two to each of the two distributors), and thirty-six wires run from the contact segments of the distributors to the primary lead outlets of the manifold.

(3) Figure 5 is a chart of the electrical connections of the system showing the pin-letter designations of

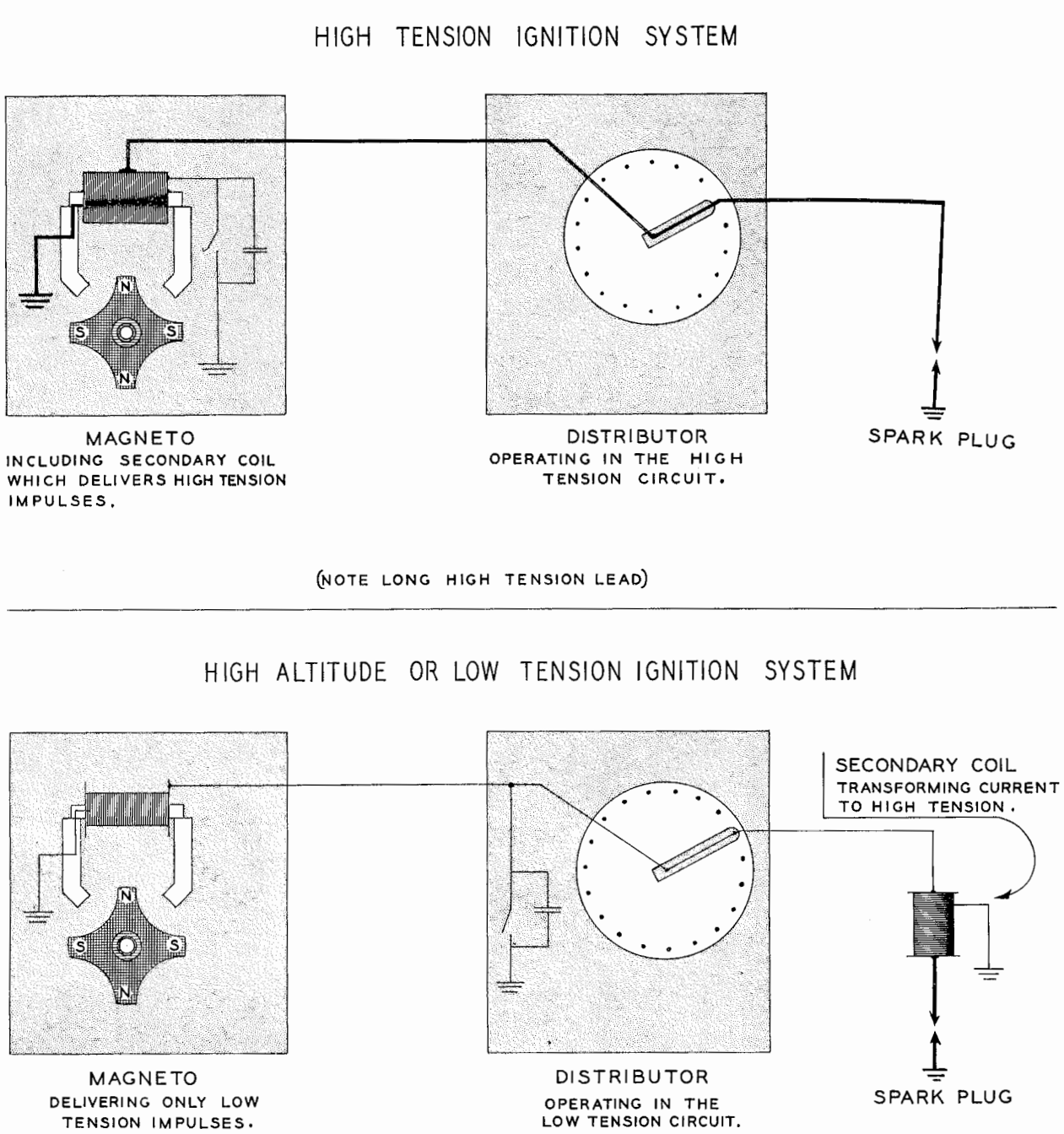


Figure 2
Diagrammatic Comparison of Low and High Tension Ignition Systems

the various electrical connectors. All wires within the manifold are No. 18 gage, insulated with rubber and fabric. Since these wires carry only a few hundred volts, the insulation requirements are not critical.

(4) The distributor bases contain the distributor blocks over which the carbon brushes of the distributor finger travel in making the proper distribution of current to the engine cylinder coils. Short lead wires attached to each segment plate make the electrical connections to the distributors which fit within the distributor bases of the harness. Figure 6 shows a view looking into one of the distributor bases. The distributor, which has been removed from its base, also appears in the picture. The segments, finger and collector rings may be seen in this photo.

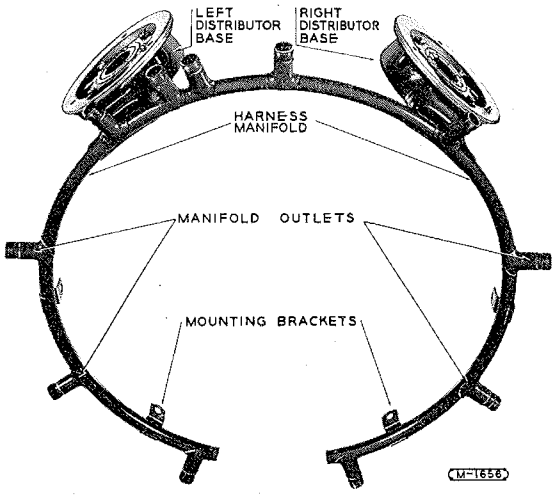


Figure 4
The Harness Assembly

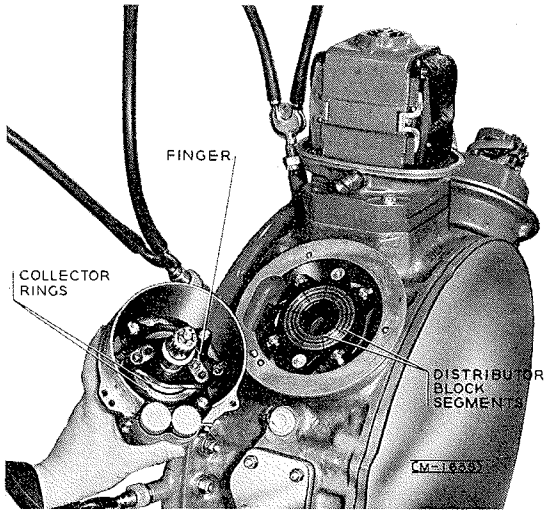


Figure 6
View into Distributor Base with Distributor Cover Removed

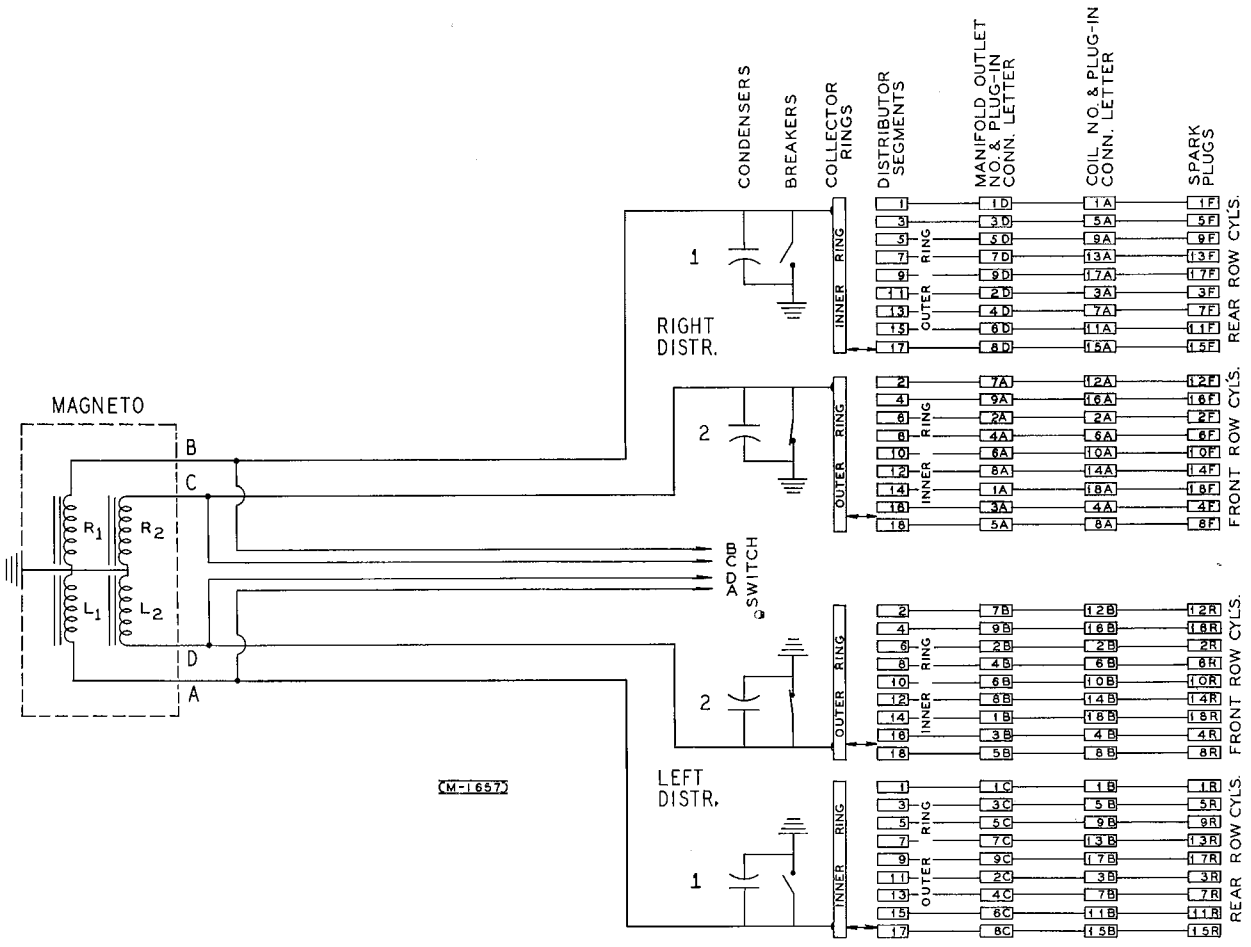


Figure 5
Chart Showing Electrical Connector Pin-Letter Designations

(5) The detachable primary leads connect the harness outlets to the transformer coils. Each primary lead is of forked construction (See figure 7), having a four-pin electrical connector at the manifold end, and a two-pin electrical connector at each of the branches which lead to the two coils.

(6) For purposes of identification, the manifold outlets are numerically designated as shown in figure

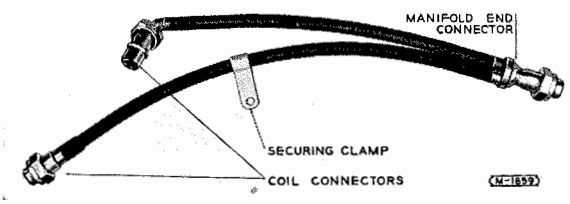


Figure 7
One of the Harness-To-Coil (Primary) Leads

8. The distributor bases are designated as left and right, as viewed from the cockpit or anti-propeller end of the engine.

(7) Within each distributor base an oil seal is mounted. The sealing ring of the oil seal assembly mates against a lapped washer on the drive shaft of the distributor unit, thereby preventing the engine oil from entering the distributor.

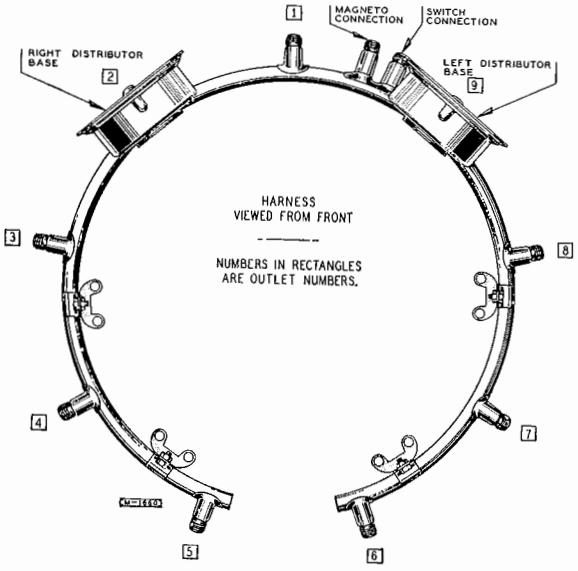


Figure 8
Sketch to Identify Manifold Outlets and Distributor Bases

c. The Distributor Assemblies

(1) The distributor assemblies fit within the distributor bases of the harness assembly. They are of clockwise rotation as viewed from the drive end. (Note that the rotation is anti-clockwise as one looks into the distributor base at the segment plate.) Each distributor is secured in position with three screws and is provided with a precision-machined cover. The cover is secured with a clamping ring which insures an electrically tight seal, preventing radio interference.

(2) The distributor shaft carries two nine lobe compensated breaker cams, a distributor finger, and the drive coupling. It also carries a lapped washer which mates against the sealing member of the oil seal in the distributor base.

(3) The breakers are mounted adjacent to the cams and are secured to a breaker plate mounted on the distributor housing. A condenser is connected across each breaker, the condensers being mounted to the housing with clamps.

(4) The molded collector plate is mounted directly over the distributor finger. The two collector rings in this plate make contact with the two carbon brushes on the upper surface of the distributor finger. The upper brushes are connected through the finger to the lower brushes, which make contact with the distributor blocks in the distributor base section of the harness.

(5) The breaker cams are of compensated design. The No. 1 lobe of each cam is marked with a dot. Each cam is also engraved with an arrow to show the direction of operating rotation. The upper cam is designated as No. "1" and operates the No. 1 breaker which in turn controls the firing of the rear row of engine cylinders. The lower cam operates with the No. 2 breaker and controls the firing of the front row cylinders.

(6) The distributor shaft turns on two ball bearings and is driven at 1/2 engine crankshaft speed. The drive end of the shaft carries a coupling of standard 17 tooth design. The upper end of the shaft is machined to provide a timing step which is used in conjunction with two timing marks to indicate the opening positions of the two breakers. Figure 9 shows the method of locating the opening position of No. 1 breaker by using a straight edge to align the shaft step with the No. 1 timing mark.

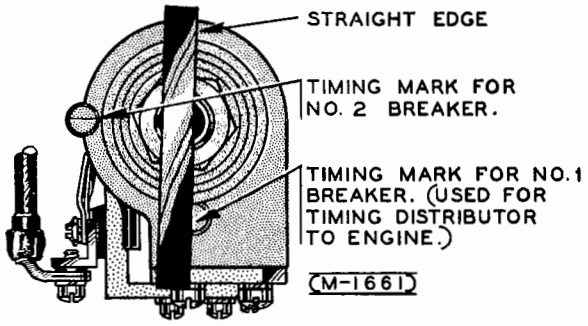


Figure 9
Use of Straight Edge to Align Timing Marks

(7) The drive coupling of the distributor is provided with vernier ratchets to permit accurate setting of the distributor when timing it to the engine.

d. The Transformer Coils and High Tension Leads

(1) Each coil assembly consists of two transformer coils permanently assembled into a single case and wired to suitable electrical connections. The coil units are mounted on special brackets secured to the baffle plates of the engine cylinders.

(2) A two-pin electrical connector forms the input connection to the coil assembly. One pin of the connector leads to the primary of each transformer coil. The other end of each primary is grounded. One end of each secondary is also grounded. The other end of

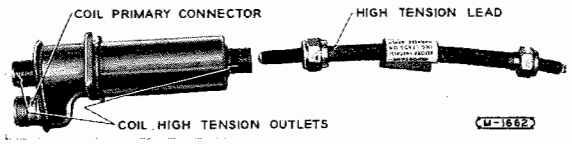


Figure 10
A Coil Assembly and one of the High Tension Leads

each secondary terminates at a high tension contact socket, one of which is at each end of the coil case.

(3) Each high tension lead fits directly into one of the high tension contact sockets of its respective coil. The leads are short, thereby reducing energy losses in the system. Figure 10 shows one of the coil assemblies with its high tension lead.

SECTION II

PRINCIPLES OF OPERATION

1. THE TYPE DLN-10 MAGNETO

a. Figure 11 is a simplified schematic diagram of the 18 cylinder high altitude system, showing the basic principle of operation.

b. In the magneto are two four pole magnets mounted on the same shaft, but staggered 45° from each other. Also in the magneto are two sets of double pole shoes and four primary coils. As each magnet rotates one revolution, it produces in each of the two coils on its pole shoes four impulses of current. Since

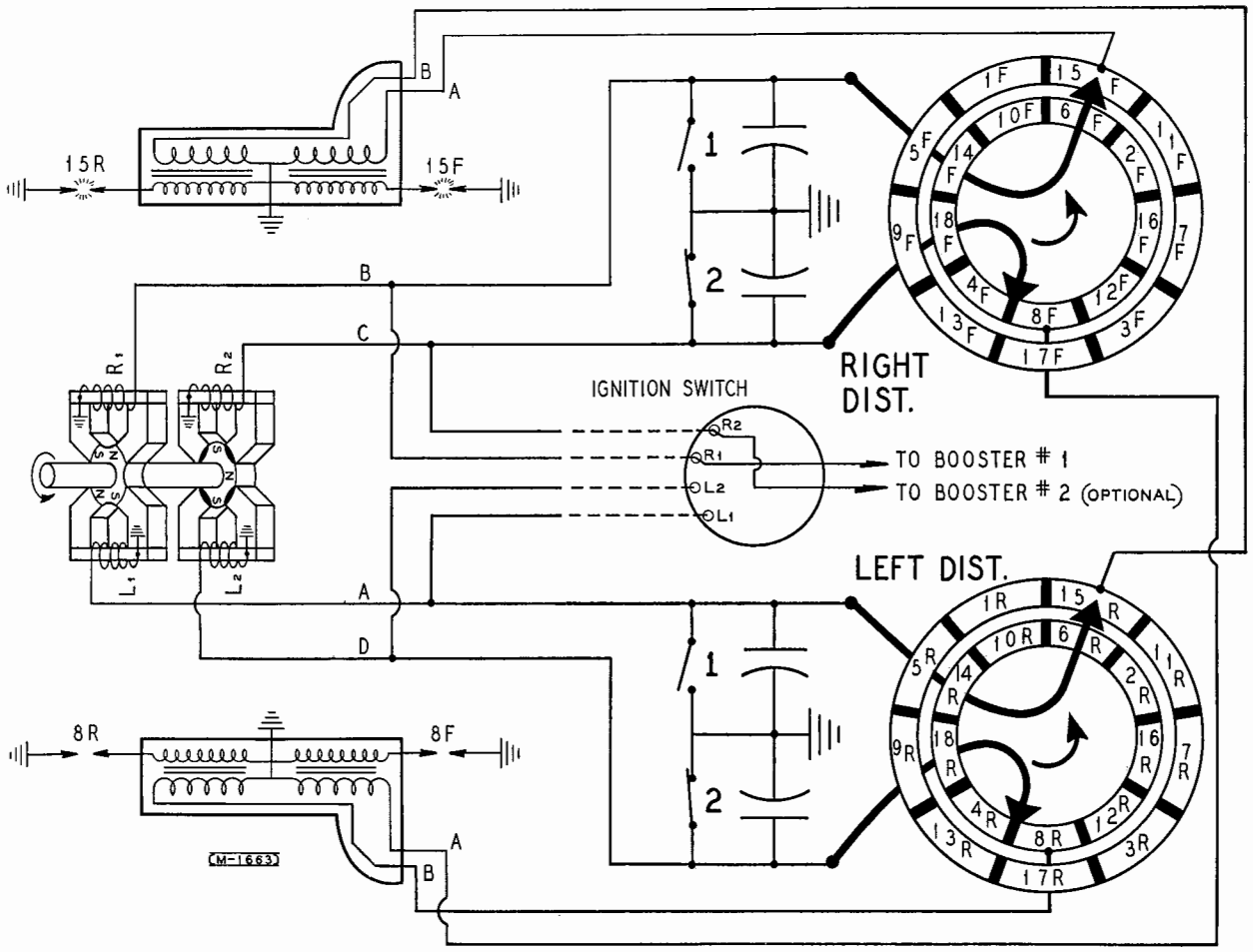


Figure 11
Schematic Diagram to Illustrate Electrical Operation of System

the magnets are staggered 45° from each other, there are eight current impulses per revolution of the shaft. And since each impulse is generated in two coils, each impulse is of dual nature. There are, therefore, eight consecutive dual impulses of low voltage current produced for each revolution of the magnet shaft. The magnet shaft is driven at one and one-eighth times engine speed. This produces nine double spark impulses per engine revolution, which is the requirement of an eighteen cylinder four-stroke-cycle engine, such as the P&W R-2800.

c. There are no secondary windings in the magneto, so the current is at a relatively low voltage, or low-tension. It is due to this fact that the system is called a Low-Tension Ignition System.

2. THE HARNESS AND DISTRIBUTORS

a. These low voltage impulses are transmitted through the harness to the distributors. The impulses from the two right hand coils in the magneto, "R–1" and "R–2", are carried to the right hand distributor, which fires the front plugs in each cylinder. The two left hand coils in the magneto, "L–1" and "L–2", are connected to the left hand distributor, and fire the rear plugs in each cylinder. As long as the breaker points are closed, there are two completed circuits in each distributor. One is through the breaker points to ground and back to the grounded primary coil. The other is out through the distributor, into the primary winding of the high-tension coil. This second circuit has a relatively high resistance, so most of the current will flow through the breaker points, the circuit having relatively low resistance. When the primary current reaches its peak value, the cam separates the breaker points, and interrupts the circuit through the points.

3. THE TRANSFORMER COIL

a. The current then is transmitted thru the primary winding in the transformer coil, and since it was at its peak value, it goes as a terrific surge. This surge induces a very high voltage in the secondary winding, which has enough electrical pressure to break down the gap between the electrodes of the spark plug and cause a spark between them. The surge of secondary current is very short-lived. It falls away quite rapidly. Then the points close again and reconnect the low resistance circuit to ground. Meanwhile, of course, the finger of the distributor has made contact with the proper segment of the distributor block, so that the surge is directed to the particular spark plug which it is desired to fire. Now, as the magnet rotates, and another impulse is building up in the primary circuit, the finger moves to the next distributor segment, and the next plug in the firing order will receive the coming surge. Also, the two distributors are synchronized and when the right one is firing a front plug the left is firing the rear plug in the same cylinder. Therefore, the two plugs in any one cylinder are each receiving a high voltage surge at the same moment assuring satisfactory ignition of the gas charge in the cylinder.

4. HOW A SPARK IS PRODUCED

a. A moment's examination of figure 11 will further clarify the action of these circuits at the instant of firing a cylinder. Assume that No. 15 cylinder is being fired. This cylinder is 17th in the firing order. Coils L1 and R1 are generating impulses in the magneto. The current goes through the harness to the distributors, L1 to the left distributor, R1 to the right distributor. Since the breaker points are opened, the current flows into the distributor finger, through the carbon brushes and to the No. 17 segment which is connected to the coil for No. 15 cylinder. It then flows through the harness to the coil for No. 15 cylinder where it is transformed into high voltage current and passes through the high tension lead to the spark plug, causing a spark at the gap. The current from the left distributor is transmitted to the rear plug, and the current from the right distributor is transmitted to the front plug. After this surge of current has ceased, the distributor finger will progress from No. 17 segment to No. 18 segment and coils L2 and R2 in the magneto will be generating impulses which will be transmitted to cylinder No. 8, the 18th cylinder in the firing order.

SECTION III

INSTALLATION

1. THE HARNESS ASSEMBLY

a. Remove the protection covers from the distributor bases. See that the mating surfaces of the distributor bases and engine distributor mounting pads are free of any dirt or chips. Place screen gasket on distributor pad.

b. Place the harness manifold assembly in position on the front accessory section of the engine, securing the distributor bases to their pads with the eight special screws. Start all eight screws before tightening any of them. Then draw all screws up evenly.

c. Secure the four harness manifold support brackets to the bosses provided on the engine, and secure the harness manifold to the brackets.

d. Connect the conduit from the ignition switch of the airplane to the switch outlet connector on the harness. (See figure 8.)

e. Safety wire all securing screws.

2. THE DISTRIBUTOR ASSEMBLIES

a. Remove the protection covers from the distributor units. See that the mating surfaces of the distributors and distributor bases are clean. See that the oil seal assembly in each distributor base is in good condition and that there are no chips or cracks in the carbon sealing ring. Install and time each distributor to the engine in the following manner:

(1) Set the engine at the firing position for No. 1 cylinder, as directed by engine manufacturer.

(2) Loosen the nut on the drive end of the distributor shaft until the drive gear can be turned, thereby actuating the timing ratchets under the drive member.

> **Note:** *Between the drive member and the timing lock which is splined to the shaft is a ratchet ring. This ratchet ring has 23 teeth on one side and 24 teeth on the other. When the drive coupling is turned to the right one ratchet tooth, the coupling moves 15.65°. Then when the coupling is turned back to the left one tooth, it moves 15°, leaving the coupling .65° to the right of its original position.*

(3) Being careful not to damage the carbon sealing ring of the oil seal, lower the distributor straight into the distributor base, engaging the dowel pin in the base with the mating hole in the distributor. Install the three securing screws, but tighten them only finger-tight.

(4) Using an open-end wrench on the large nut at the upper end of the distributor shaft, ratchet the shaft to the position where, with the ratchets fully

engaged, a straight-edge, held against the timing step of the shaft, will line up exactly with the No. 1 breaker timing mark on the top of the distributor. (See Figure 9.)

(5) Be sure the ratchets are fully engaged. This is evidenced by a noticeable click and a tendency to locate positively in the engaged position. If the ratchets are not fully engaged at the instant the timing marks line up, the ratchet teeth will shift slightly when the drive shaft nut is tightened, necessitating repetition of the timing operation.

(6) Remove the distributor. Tighten and cotter pin the drive shaft nut, making sure the ratchet teeth are fully meshed and do not shift when the nut is tightened. Then again install the distributor, having the straight edge and timing mark lined up as before. When assembled, the straight edge and timing mark must line up precisely, as shown in figure 9. If this alignment is not obtained, remove distributor and readjust the ratchets to obtain exact alignment of the straight edge with the timing mark. Tighten the three distributor securing screws.

(7) Install the second distributor in the same manner as the first. Then connect a timing light to the No. 1 breaker of each distributor. Rock the engine backward about a quarter turn and then forward again to the exact No. 1 firing position, at which time the No. 1 breakers of both distributors should open simultaneously as indicated by the timing light. If necessary, shift either distributor slightly until the No. 1 breakers of both distributors open at the same instant at the exact No. 1 firing position of the engine.

(8) Connect the primary leads from the segment plate of each distributor base to the collector plate of each distributor assembly. To do this, remove the screws which secure the condenser leads to the collector plate of the distributor. Then assemble in this order: primary connectors, primary condenser terminals, plain washers, lock washers, and screws, and secure the parts in position.

(9) Place the distributor covers in position and secure with the clamping rings.

(10) Safety wire all securing screws.

3. THE DLN-10 MAGNETO

a. If not already done, set the engine at its No. 1 cylinder firing position as specified by the engine manufacturer. This is the same position used for installing the distributors.

b. See that the magneto flange and engine mounting pad are clean and free of any foreign particles. Install a new gasket to the engine mounting pad.

c. Remove the safety clip from the timing plunger which is located near the base of the magneto. Press the plunger in and turn the magneto shaft until the plunger engages one of the notches in the shaft, thereby locating the magneto in its firing position. There are four notches in the shaft, any one of which may be used for this preliminary setting.

d. While still holding the plunger engaged with the notch in the shaft, put the magneto on the engine engaging the drive spline with the mating engine part in such a relation that the magneto securing screws will be approximately centered in the elongated slots in the magneto mounting flange. If the magneto cannot be installed in this relation, remove it and turn the magneto shaft 90 degrees until the timing plunger engages in the next notch in the shaft. Again install the magneto on the engine. If necessary, turn the magnet shaft to a new position a second time in order to have the mounting studs approximately centered in the elongated slots when the magneto is finally installed. When the correct adjustment has been obtained, secure the magneto in position and recheck the adjustment.

e. Connect the magneto outlet conduit to the magneto connection on the harness manifold. (See Figure 8.)

f. Safety wire all securing screws and electrical connectors.

4. THE TRANSFORMER COILS, PRIMARY LEADS, AND HIGH TENSION LEADS

a. Install the high tension leads to the coils. Tighten the securing nuts firmly and secure with safety wire. Secure the transformer coils to the baffles on the engine cylinders by means of the brackets provided. The end of the coil having two connector bushings must face the front or propeller end of the engine.

b. Connect the nine primary lead assemblies to the nine outlets on the manifold by engaging the four-pin electrical connectors, taking care to have the connector keys properly lined up. Connect the long branch of each lead to the coil on the rear cylinder and the short branch to the coil on the front cylinder.

c. Connect the high tension leads from the coils to the spark plugs. When tightening the securing nuts be sure the lead shielding conduit is not cramped or twisted.

d. Safety-wire all electrical connections and securing screws.

SECTION IV

LUBRICATION

1. The ball bearings of the magneto and distributors, and all working parts of the system are properly lubricated when assembled, and do not require further lubrication between overhauls. Therefore no lubrication procedures are applicable to this system.

SECTION V

INSPECTION AND MAINTENANCE

1. INSPECTION

a. At 300 hour inspection periods remove the safety wires and take off the clamping rings and the distributor covers.

b. Inspect the breaker points in each distributor. A flashlight will probably be needed for this operation. If the points appear to be burned or fouled, replace. The burned assemblies can be reconditioned as instructed in Section VI, paragraph 2c.

c. Inspect all electrical connections to see that they are tight and secure.

d. Connect a timing light across the No. 1 breaker. This is the upper breaker and is plainly marked with a "1" engraved on the breaker plate. Hold a straight edge against the step cut in the distributor shaft and turn the engine until the straight edge lines up exactly with the No. 1 breaker timing mark on the top of the distributor. (See Figure 9.) At this position, the contact points of No. 1 breaker should be just opening as shown by timing light.

e. If the No. 1 breaker does not open at this position, slightly loosen the two screws which secure the breaker assembly to the breaker plate. Then by means of the adjusting eccentric, shift the breaker until the points are just opening. Tighten the breaker securing screws and recheck the setting.

f. Turn the engine to the position where the straight edge lines up with the No. 2 breaker timing mark. Connect the timing light across the No. 2 breaker and adjust this breaker to open at this position.

g. No other service should be necessary between overhaul periods. If operating difficulties are experienced refer to Paragraph 2 of this section entitled "Trouble Shooting".

CAUTION

Before attempting to remove a distributor from the engine always be sure to remove the primary lead wires which connect the collector plate to the segment plate. The molded plates may be broken if an attempt is made to remove the distributor with these lead wires in place.

2. TROUBLE SHOOTING

a. It is practically impossible to foresee all causes of trouble in any mechanical device, especially when one is concerned with such a complex mechanism as an eighteen cylinder aircraft engine. This section is written with the thought of suggesting some of the checking procedures which are most likely to expose the source of trouble.

b. These suggestions assume that certain work has already been done. First, that the trouble has been quite definitely traced to the ignition system. Second, that the booster has been checked and is functioning properly, that the spark plugs have been examined and found to be in good condition or have been replaced, and that the airplane ignition switch and its cables to the magneto have been inspected and proven to be in good condition. In other words, this section deals only with the ignition system proper, including the magneto, the two distributors, the harness, the transformer coils, and the high-tension leads.

c. There are certain basic facts about trouble shooting that you can infer from studying the electrical diagrams of the systems in this book. For example, if an engine misses on all front plugs in the front row, you would remember that the right distributor fires the front plugs and that the number two breakers fire the front row of cylinders and this should lead you to investigate the contact points of the No. 2 breaker in the right distributor and also the harness wiring and magneto coil No. R2 which are in the circuit with this breaker.

d. On the other hand if the engine misses consistently on only one plug, say No. 13R, you would deduce the trouble to be somewhere between the distributor and the troublesome plug. You would feel pretty certain that the trouble was not in the magneto, the contact points, or the condenser because the other plugs which these parts serve are working properly. Therefore a logical approach would be to check the high-tension lead and coil which serve this plug and if this does not disclose the trouble, to check for continuity or shorts back to the distributor segment which is connected to this coil.

e. Trouble shooting by the above method would be fairly simple if it were not for the fact that sometimes it is very hard to tell which cylinder is missing—or even whether one or two cylinders are out. To make this matter easier, the following procedure is recommended as a practical routine check of the entire system.

(1) Observe the rpm drop on both sides of the ignition system by operating the switch.

(2) Remove and inspect all plugs on the side which has the greatest rpm drop. Remove all spark plug leads from all plugs.

(3) Remove the switch lead conduit from the harness and connect the No. 11–2632 tester into the switch connector of the harness.

(4) Be sure the correct plug is removed from EACH cylinder. Following the instructions provided with the No. 11–2632 tester, turn the engine through two complete revolutions and observe for sparking at each firing position. This procedure affords a check on all components of the system—both primary and secondary, and will show which plug is not firing.

f. Should you not have a No. 11–2632 tester, you can conduct a similar test using a substitute method. The low tension or induction vibrator starting coil on the airplane can be used for a source of current impulses.

g. Proceed as instructed in steps 1 and 2 above, then take off the cover of the induction vibrator starting coil or "booster" and disconnect the starting vibrator input wire which comes from the switch or starter jaw-engaging solenoid. Connect a length of insulated wire to the battery input terminal on the booster. This wire should be long enough to reach a live 24 volt battery connection on the plane, however don't connect it up yet.

h. Disconnect the switch conduit connector at the harness. Provide a short jumper wire which can be connected between the two parts of this connector. Connect one end of the jumper wire into the hole

marked "C" in the switch wire conduit. By connecting the other end of this jumper wire to the pins of the switch connector on the harness you can check the firing of the plugs in each row of cylinders in the following manner.

i. If you removed the front plugs, connect the jumper wire to pin "B". This will feed the booster current to the front plugs of cylinders 1, 5, 9, 13, 17, 3, 7, 11, and 15. Connect the long wire from the booster to a live 24 volt battery connection on the airplane and the booster will operate. Then turn the engine through two revolutions and observe the front spark plugs of the rear row cylinders, which will spark in the sequence listed above. Note that this method checks the rear row of cylinders as if it were a single nine cylinder engine.

j. Now connect the jumper to pin C and repeat the same test on the front plugs in the front row of cylinders. (This will check Nos. 2, 6, 10, 14, 18, 4, 8, 12, 16.)

k. If you removed the rear plugs, connect the jumper to pin A which will fire the rear plugs in the rear row. Pin D will fire the rear plugs in the front row. Note again that each of these tests treats the particular row of cylinders as if it were a single nine cylinder engine.

Caution: *Do not operate the booster for longer than about one minute at a time or it will get too hot.*

l. If, during the above checks, any plug fails to spark in its proper order, investigate the cables which feed it. When checking out the distributor head connections remember that the numerals engraved on the head are the sparking order and not the cylinder numbers. You can easily determine the cylinder numbers, however, from the table, figure 5.

m. As a further aid in trouble-shooting, the chart shown below and the list of possible causes of trouble which follow it, have been prepared. These are not meant to be complete or infallible, but may help mechanics who are unfamiliar with the system to get started. The chart and the list of possible causes of trouble are intended to be used together, the more common engine trouble symptoms being keyed by letters and numerals to their most probable causes

n. Chart of Engine Trouble Symptoms

CHART OF ENGINE TROUBLE SYMPTOMS

Engine Trouble Symptoms	*Possible Causes to be Checked (See List of Possible Causes of Trouble Below)*
1. Engine fails to start on booster.	A. Distributor—Check 1, 2, 3, 4, 5, 6, 7 B. Harness—Check 2, 3, D. Magneto—Check 1, 3, 4, 5.
2. Engine starts but fails to run when booster switch is released.	D. Magneto—Check 1, 2, 5, 7.
3. Engine seems smooth on either side but has excessive drop on one side.	A. Distributor—Check 1, 3, 4, 5, 6, 7 B. Harness—Check 2, 3 D. Magneto—Check 1, 3, 4, 5, 6.
4. Engine seems rough on either side, drop about equal.	C. Coils and H. T. Leads Check 1, 2, 3, 4. D. Magneto—Check 1, 2, 3, 4, 5, 6.
5. Excessive drop and roughness on one side only.	A. Distributor—Check 1, 2, 3, 4, 5, 6, 7. B. Harness–Check 1, 2, 3. C. Coils and H. T. Leads Check 1, 2, 3, 4, 5, 6. D. Magneto—Check 1, 3, 4, 5, 6.
6. Engine cuts out on one side.	A. Distributor—Check 1, 3, 4, 5, 6, 7. B. Harness—Check 2, 3. D. Magneto—Check 1, 4, 5.
7. Engine is rough at high power.	A. Distributor—Check 1, 2, 3, 4. B. Harness—Check 3. C. Coils and H. T. Leads Check 1, 2, 3, 5.

o. Possible Causes of Trouble

POSSIBLE CAUSES OF TROUBLE

A.—Distributor

1. Dirty or broken carbon brushes.
2. Foreign particles short-circuiting segments.
3. Dirty or glazed contact points.
4. Breaker out of adjustment.
5. Distributor incorrectly timed to engine.
6. Primary condenser defective.
7. Broken primary lead, harness-to-distributor.

B.—Harness

1. Broken or shorted primary wire, distributor-to-coil.
2. Broken or shorted primary wire, magneto-to-distributor.
3. Loose connection in distributor block.

C.—Coils and High-Tension Leads

1. Loose plug-in connector at coil.
2. Moisture or dirt in coil high-tension sockets.
3. High-tension lead insulation defective.
4. Coil primary open circuited.
5. Coil secondary defective.

D.—Magneto

1. Plug-in connector loose at magneto.
2. Magneto incorrectly timed to engine.
3. Magneto coil wire loose.
4. Magneto coil loose.
5. Wiring in magneto defective.
6. Magneto coil defective.

SECTION VI

OVERHAUL PROCEDURE

1. THE DLN-10 MAGNETO

a. Disassembly

(1) Take off safety wire, clamping ring, and magneto cover.

(2) Disconnect the primary leads from R2 and L2 coils and remove coils. It will be necessary to remove R1 and L1 coils from the housing before detaching the primary leads, as the terminal securing screws are not otherwise accessible.

(3) Remove the cotter pin and take out timing plunger and spring.

(4) Take off safety wires and remove the four screws which secure the lower ball bearing adaptor to the housing.

(5) Insert two of the adaptor securing screws (1/4-28 thread) into the threaded holes in the ball bearing adaptor. Advance these screws into the adaptor evenly, thereby withdrawing the complete assembly of adaptor, drive coupling, magnet, and bearings, until the adaptor pilot is disengaged from the housing. Then place a fiber or hard wood drift against the upper end of the shaft and tap it lightly with a mallet until the complete magnet assembly is released from the housing.

(6) Bend back the ear lock washer under the hexagon nut at the upper end of the magnet. Hold the drive coupling with No. 11-1523 spline wrench and remove the nut. Then remove the drive shaft cotter pin and drive shaft nut.

(7) Remove the ball bearing from the upper end of the shaft, and the complete adaptor, bearing, oil seal, and drive member parts from the lower end of the shaft.

(8) Cut the safety wires and remove the six screws which secure the oil seal and bearing retainer in the front bearing adaptor. Push out the bearing and its retainer containing the oil seal. Remove the oil seal sleeve if it should remain within the oil seal assembly.

(9) Remove the ventilators from the cover and housing. The ventilators must be unscrewed by using a wrench on the hexagon section and NOT by gripping the slotted body.

b. Cleaning

(1) All parts except the coils and ball bearings may be washed in kerosene or equivalent solvent and dried with an air blast.

(2) Do not immerse coils or ball bearings in any liquid. Wipe these parts with a cloth moistened with a few drops of engine oil.

c. Inspection and Repair

(1) Examine the housing to see that there are no cracks and that the laminations are all tight in position. See that all threaded holes are clean and that the threads are in good condition. Examine the primary connector conduit for evidence of damage. If the conduit or elbow is bent or crushed, new parts must be installed. See that the primary lead wires are in good condition and that the insulation is not chafed or deteriorated. Check the continuity and insulation resistance of the wires using the No. 11-3030 tester, as follows:

(*a*) Connect the metal case of the No. 11-3030 tester to a good ground such as a water pipe. Be sure the toggle switch on the panel is in "OFF" position then plug the tester lead cord into a receptacle delivering 115 volts 60 cycle alternating current. See that the voltage control (the large knob at the left of the panel) is turned to the LEFT as far as it will go. Place the large toggle switch at the lower left corner of the panel in the "CONTINUITY" position. Turn on the tester and plug the test leads into the jacks marked "CONTINUITY" and "GROUND" at the lower right hand corner of the panel. Touch the two test leads together to check the operation of the test lamp. When the test leads are touched together the indicator lamp in the panel should light.

(*b*) Connect one test lead to the coil end of the wire which is to be tested and the other test lead to the magneto conduit connector socket which is at the other end of the wire. Figure 5 shows the connection of the wires inside the magneto.

(*c*) When the connection is made, the lamp in the tester should come on, indicating a satisfactory circuit through the lead. Be sure to recheck all your connections if you should encounter an open-circuited wire, to make sure that the tester is correctly connected.

(*d*) For the high-voltage test of the insulation, connect the test lead from the "GROUND" jack of the No. 11-3030 tester to the metallic housing of the magneto. Push the large toggle switch on the panel to the "1000 VOLTS" position. DO NOT TOUCH THE METAL TERMINAL OF THE HIGH VOLTAGE TEST LEAD.

> **Caution:** *This tester is capable of delivering a severe shock if the operator accidently touches the high tension lead while the power is on. Therefore the customary precautions usually observed in connection with high voltage instruments should be taken in using this tester.*

(*e*) Turn the voltage control of the tester to the right until the meter needle is exactly over the "1.0" graduation at the right hand end of the meter scale. The tester is now delivering a 1000 V. D. C. test potential across the lead terminals.

(*f*) Holding the high voltage test lead by its insulated handle, check each wire in the magneto for leakage. This is done by touching each of the coil lead terminals in turn with the high voltage terminal of the tester, and noting the meter reading for each wire. Should the meter read less than .8 on any wire, the insulation of that wire is defective and all wiring should be replaced. The .8 milliampere reading on this tester corresponds to an insulation resistance of approximately 1 megohm.

(2) Should any wire show a discontinuity or low insulation resistance, or if the conduit is bent or crushed, rewiring is recommended. To rewire, precede as follows:

(*a*) Push back the insulators on the coil leads and cut off the lead terminals. Remove terminal insulators and insulation sleeves. Push the lead wires through and withdraw them in the drive shaft opening of the housing. Disengage the conduit coupling nut and remove conduit from magneto, at the same time pulling the wires out.

(*b*) With a pair of thin nosed pliers pull each socket out of the connector on the conduit, at the same time withdrawing the wire. When all four wires have been removed, insert jaws of thin nosed pliers into two diagonally positioned holes in rubber connector insert and pull insert and grommet from connector.

(*c*) Cut two new lengths of wire, one red and one green, each thirty-six inches long. Double each wire in its middle and slip the two ends through adjacent holes in the grommet of a new connector insert. Strip the wires and solder two ends of red wire to sockets A and D in the connector; green wire to sockets B and C.

(*d*) Push folded ends of wires through conduit and elbow then through bushing in magneto housing. Line up connector sockets with keyway as shown in Figure 12 and press insert into shell. Double wires back and thread through narrow passage in housing, separating them so red wires lead to L side of magneto, green wires to R. Cut loop of each wire and by means of test light determine identity of wires. Wire from "A" socket goes to L1, "B" to R1, "C" to R2, "D" to L2.

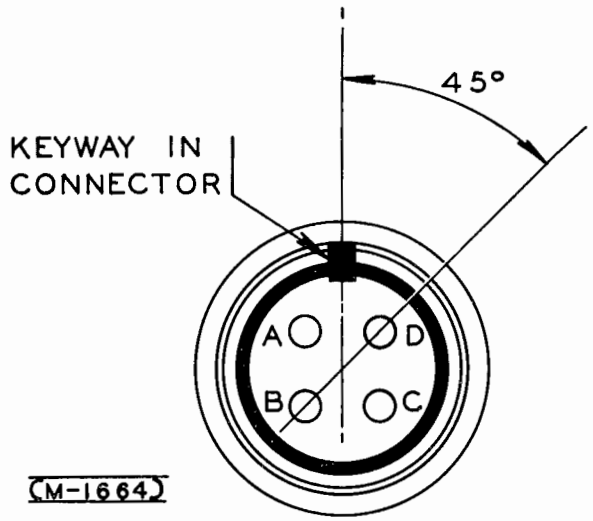


Figure 12
Relation of Connector Sockets to Key in Magneto Connector

(*e*) Pull wires tight. Temporarily install new terminals to coils, and coils to magneto. Dress new wires into position occupied by old wires in groove. Gage length of new wire in relation to terminal; allow one inch for slack and soldering to terminal. Cut wires to proper length.

(*f*) Thread on insulating sleeves and rubber terminal insulators. Loop wire through terminal sleeve and solder, using old wires as sample. Push terminal insulator up over terminal, insulating sleeve over insulator. Dress wires into position and secure No. 2 wires with clamp.

(3) Wipe the pole shoes in the housing carefully. The laminations in the poles should be easily seen. Check carefully for any burrs anywhere on the laminated surfaces. If laminations are damaged the housing must be replaced. Never use a file or emery cloth on the laminated surfaces. After cleaning, coat all exposed metal surfaces of the laminations with a thin film of Andok "C" grease to keep them from rusting.

(4) Check the bearings for smooth operation by turning with the hand. Do not attempt to clean or to lubricate the bearings. If rough or excessively loose, replace. If a bearing has been in operation for 1500 hours or more, replace in any event. Check the bearings for a slip fit on the magneto shaft. If foreign material is present clean very carefully with a fine crocus cloth. Do not let any abrasive dust work into the bearing.

(5) Inspect the coils. See that the under side of the core, where it rests on the pole shoe, is clean. See that the insulation is not chafed and the terminal connector is secure.

(6) Give the rotating magnets a very close visual check for any scratches or burrs on the pole pieces. Wipe the magnet clean. The magnet material used in these magnetos is Alnico V, an alloy which has exceptional ability to retain its magnetism. Owing to the high coercive force of this material, the magnet will not ordinarily require recharging during the service life of the magneto. For this reason a routine recharging of the magnet during overhaul is not recommended. However, in cases where a magnet has been intentionally discharged for shipping or storage purposes, or where it has been inadvertently discharged by the incorrect connection of boosters or other accessories, recharging may be necessary as evidenced by a low output at the time of final test of the magneto. If recharging is necessary, it must be

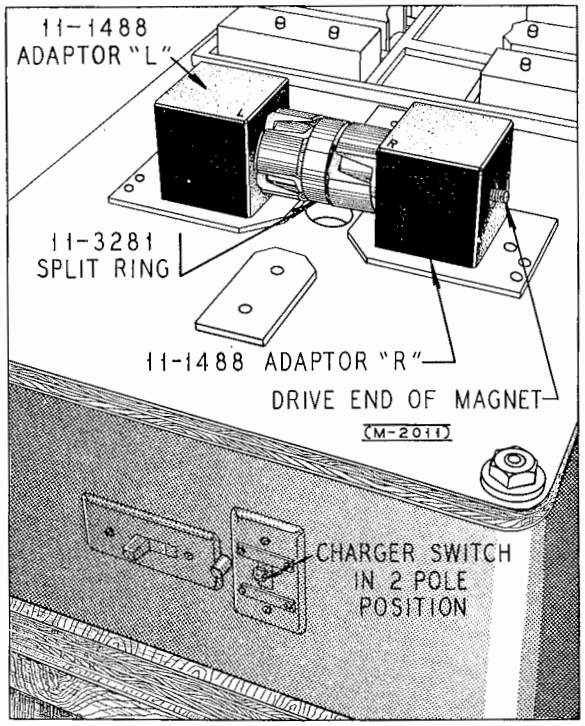


Figure 13
Charging The Magnet

done on a Weidenhoff No. D818 magnetizing machine, using Scintilla Adaptor Set No.11–1488 and split ring No. 11–3281. The magnet is charged as a two pole magnet, and care should be taken to arrange the adaptors and split ring exactly as shown in Figure 13 in order to obtain a proper magnetic charge. NOTE: Magnetizing adaptor sets, No. 11–1488 of early execution will not accommodate the rotor of the DLN–10 magneto without reworking. Should it be found that the magnet will not fit the No. 11–1488 adaptor set, the adaptors must be reworked by counter-boring as shown in Figure 14. Magnetizing adaptor sets as currently supplied will accommodate the DLN–10 magnet without reworking.

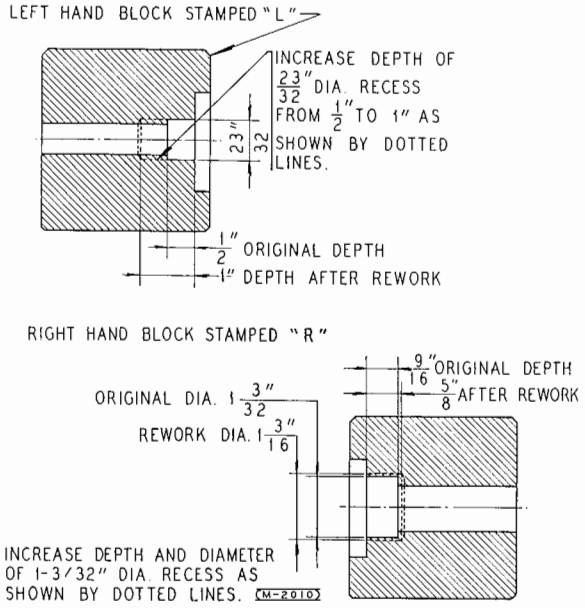

LEFT HAND BLOCK STAMPED "L"
INCREASE DEPTH OF 23/32" DIA. RECESS FROM 1/2" TO 1" AS SHOWN BY DOTTED LINES.
23/32"
1/2" ORIGINAL DEPTH
1" DEPTH AFTER REWORK
RIGHT HAND BLOCK STAMPED "R"
ORIGINAL DIA. 1 3/32"
REWORK DIA. 1 3/16"
9/16" ORIGINAL DEPTH
5/8" AFTER REWORK
INCREASE DEPTH AND DIAMETER OF 1-3/32" DIA. RECESS AS SHOWN BY DOTTED LINES.
CM-2010

Figure 14
Rework of No. 11-1488 Adaptors

(7) Check the metal braid sealing strip in the parting surface of the cover. If the braid wires are broken or if the strip is loose or deformed it should be replaced. Pry up one end of the old strip and pull it out of the groove. Clean the sealing groove of all foreign material by wiping with a cloth moistened in clean unleaded gasoline.

(*a*) About 22 inches of sealing strip will be required for each magneto. This will allow a small margin for trimming at each end and a small amount for shrinkage which occurs during installation.

(*b*) Wipe the entire length of gasket clean with a cloth moistened with naptha or unleaded gasoline to remove any greasy deposit or other foreign matter.

(*c*) Apply a light coating of DC–4 compound or white vaseline over the entire length of the gasket so as to penetrate the cotton threads. The above application will prevent corrosion of the aluminum parts at the point of contact.

(*d*) Start laying the gasket in the groove adjacent to a screw hole location. The gasket must be inserted without stretching.

(*e*) After the gasket has been installed, the loose end should be cut to closely match the end already in the groove, so as to make a neat joint where they meet.

(*f*) The gasket must be well seated in the groove by light blows of a fiber or phenolic hammer having an unmutilated face, or it may be formed into position in the groove by means of a flat block of wood. The surface of the gasket when formed into position should be about .015" above the parting surface. It is considered satisfactory if the gasket is firmly seated in the groove so that the part can be handled and the gasket will not loosen at the joint or fall out of its own weight.

(8) Inspect the mounting flange. See that the ventilator hole is open. Inspect mounting lugs for cracks. See that the aligning dowels in the cover seating surface are unmutilated and secure.

(9) Inspect the oil seal for wear. Replace if wear or signs of leakage are evident. Replace the oil seal sleeve on the shaft if it is scored or worn.

d. Reassembly

(1) Assemble the drive end bearing into its adaptor. If the bearing cannot be readily pushed in by hand, heat adaptor to about 200°F, while keeping the bearing at room temperature. This will expand the adaptor so that the bearing can be easily inserted.

(2) Press the oil seal into the bearing retainer. The open side of the seal (having the fiber ring) must face the side of the retainer on which the screw holes are counterbored. Support the retainer upon a block of hard wood and use a second block of hard wood against the seal, for the pressing operation.

(3) Push the oil seal sleeve into the oil seal from the rear (trade marked side) of the seal. Position the sleeve so it is approximately centered in the seal. Then assemble retainer, seal, and sleeve to adaptor, counterbored side of screw holes out, and secure with six screws and lock washers. Safety wire the screws in pairs.

(4) Assemble the adaptor to the magnet. Install drive coupling and secure with special washer, lock washer and nut.

(5) Assemble the upper bearing, a new ear lock washer, and the hexagon nut to the top of the magnet shaft. Hold drive coupling with No. 11–1523 spline wrench and tighten nut securely. Then lock in position by bending up ears of washer.

(6) Press the complete magnet assembly into the housing and secure with four 1/4–28 screws, plain washers and lock washers. Install cover and secure with clamping ring. Assemble ventilators to housing and cover.

2. THE DISTRIBUTOR ASSEMBLIES

a. Disassembly

(1) Remove the connector leads from the breakers, condensers, and collector plate. Take out the four screws which secure the breaker plate to the housing and remove the plate with breakers attached.

(2) Remove drive shaft cotter pin. Hold drive coupling with No. 11–1239 spline wrench and remove nut. Take off the washers, spring, drive coupling, ratchets, lapped washer, and shims.

(3) Remove the spacer sleeve from the drive shaft. If this sleeve sticks, it is suggested that a strip of fine

sandpaper be wrapped about it as a means of obtaining a better grip. Remove the rubber seal ring which fits in the annular groove in the shaft. Lift out the distributor finger.

(4) Remove the collector plate. Take out the large ball bearing retainer screws and remove retainer. The complete shaft with bearings and cams can now be pressed out of the housing by using a fiber or hard wood drift to protect the upper end of the shaft.

(5) Bend back the ear lock washer under the hexagon nut at the end of the shaft, being careful not to damage the shield of the bearing. Apply an end wrench to the flat of the shaft and remove the hexagon nut. Remove the small bearing, upper cam, upper cam key, lower cam, and large bearing. It is not necessary to remove the keys for the lower cam and distributor finger.

b. Cleaning

(1) With the exception of the condensers, connector leads, breaker contact assemblies and ball bearings, all parts may be washed in kerosene or an equivalent solvent and dried with compressed air. Do not wash the finger and collector plate together with the other parts as this might allow some of the sharp edged parts to scratch or nick the collector rings or to chip or break the carbon brushes.

(2) Do not immerse the condensers in any liquid. Wipe condensers with a cloth moistened in gasoline.

(3) Do not immerse the ball bearings in any liquid. Wipe bearings with a cloth moistened in gasoline. Then wipe with a clean cloth which has been allowed to absorb a few drops of light engine oil.

(4) It is not ordinarily necessary to remove the breaker assemblies from the breaker plate because the wear in the breaker is normally very slight. Disassembly and dressing of the contact points should NOT be made a regular routine step of the overhaul procedure. In a majority of cases, the contacts will be found satisfactory when removed from the distributor at overhaul time, and in this instance a simple cleaning, inspection, and lubrication routine is all that need be performed. Wash the entire assembly in clear CLEAN gasoline to remove all oil. Use a small brush (such as a tooth brush) to work around the points and to scrub the felt of the cam follower lightly in order that any particles of dirt or grit will be removed. (See figure 15.) Blow the assembly dry with compressed air directed over all parts of the assembly, particularly the follower felt and the point surfaces, which should be held apart to evaporate all traces of the solvent and remove any dirt which may have lodged between them. If the cleaning has been properly done, the felt strip should come out nearly white when dry. If the felt does not appear thoroughly clean, repeat the washing, working the solvent thoroughly into the felt with the fingers. Be sure all solvent is removed from the felt.

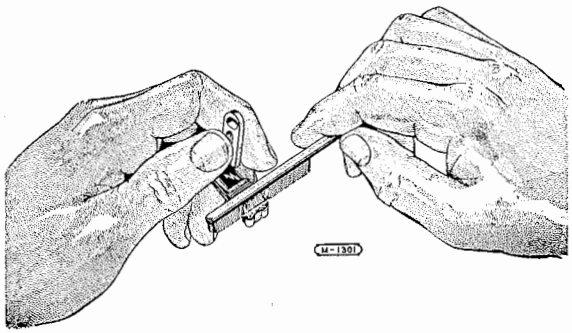


Figure 15
Scrubbing Cam Follower

c. Inspection and Repair

(1) Inspect the breaker assemblies. See that the cam follower felt is in good condition and securely fastened to the follower. Make sure none of the threads which bind the tail of the strip are broken. Use a new follower, if the felt is loose or torn or if there are any broken threads. Check the fiber block of the follower for excessive wear at the point where it lifts against the mainspring. After long periods of operation there will be a certain amount of normal wear at this point, causing a small depression to be worn in the top of the fiber block. If the bottom of this depression is less than 1/32-inch from the top of the springs to which the fiber is riveted, the fiber is worn beyond safe limits and should be replaced. (See figure 16.) Check the bottom of the follower block for excessive wear or a "battered" condition. The surface which rides the cam should be smooth and hard. If there is any evidence of splitting or cracking of the fiber, the follower should be replaced. Check the follower for loose rivets which secure the fiber block to the springs. This may be done by applying a light twisting force to the block while holding the spring. If there is any looseness or movement of the block or the rivets with respect to the spring, the follower should be replaced.

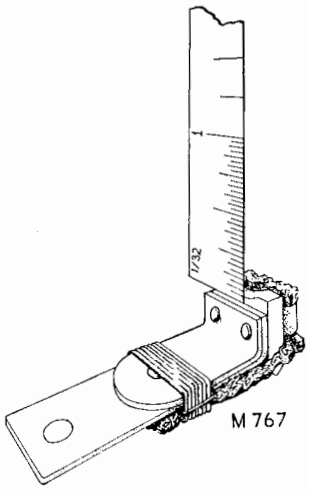


Figure 16
Measuring Wear of Cam Follower

(2) Figure 17 shows how the average contact point will look when the surfaces are separated for inspection. The contact surfaces have a dull gray, sandblasted appearance (almost rough) over the area where electrical contact is made. This gray frosted surface means that the points are worn in and mated to each other, thereby providing the best possible electrical contact, and the highest efficiency of performance. Points in this condition should not be disassembled, nor should the assembly securing screw be loosened or tampered with, since this would

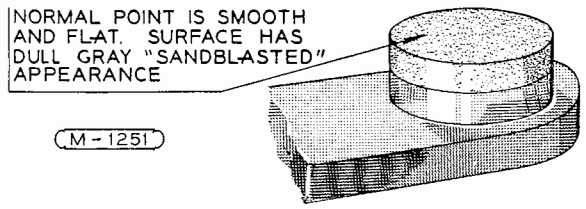


Figure 17
Normal Contact Point

change the relation of the points and destroy the perfectly mated fit of their surfaces.

(3) Minor irregularity or roughness of the point surfaces is not harmful. Neither are small pits or mounds, if not too pronounced. It is sometimes difficult to judge whether a point is pitted deeply enough to require dressing, because this depends on how much of the original platinum pad is left on the point surface. The danger arises from the possibility of the pit becoming deep enough to penetrate through the platinum pad, which may be thin due to long service or previous dressing operations.

(4) To assist mechanics in judging the thickness of the platinum pad, the No. 11–1871 gage has been provided. The point is checked by applying the gage in the manner shown in figure 18. A point is satisfactory if its contact surface is level with or extends above the surface of the gage. If any part of the point surface is below the gage surface, the platinum is too thin for safe use and a new point assembly should be installed. Points which pass the gage check are considered satisfactory for operation through one overhaul.

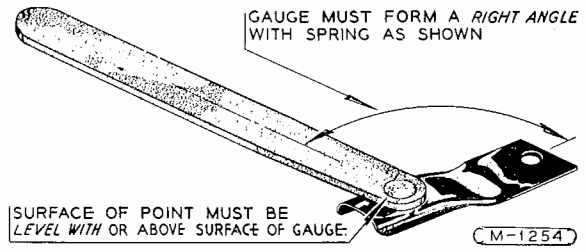
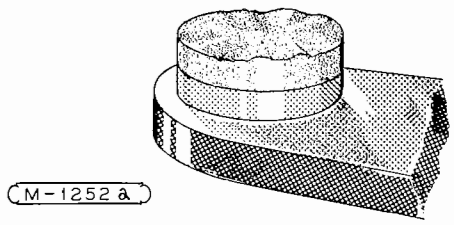


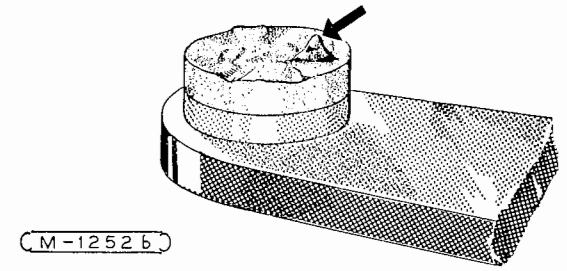
Figure 18
Application of No. 11–1871 Gage

(5) In the absence of qualified experience, it is safest to redress the points if there are any well-defined mounds on either surface. Figure 19a and 19b will help the reader to understand the difference



MINOR IRREGULARITIES – SMOOTH ROLLING HILLS AND DALES WITHOUT ANY DEEP PITS OR HIGH PEAKS. THIS IS A NORMAL CONDITION OF POINT WEAR.

Figure 19a
Point with Minor Irregularities



WELL DEFINED MOUND EXTENDING NOTICEABLY ABOVE SURROUNDING SURFACE. THE MATING POINT HAS A PIT OR HOLE CORRESPONDING TO THE MOUND SEEN HERE *THESE POINTS NEED DRESSING.*

Figure 19b
Point with Well-Defined Mounds

between "minor irregularities" and "well-defined mounds" as covered in the above discussion.

(6) Check the tension of the mainspring. Use a spring scale (tool No. 11–2731), with the hook under the mainspring, next to the point. (See figure 20)

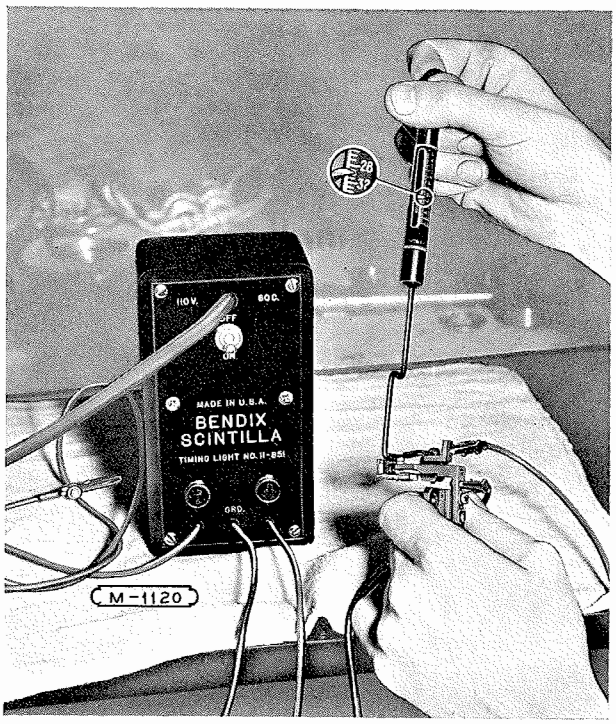


Figure 20
Checking Breaker Main Spring Tension

(7) Have a timing light (tool No. 11–851) connected, a red lead to the small angle piece, and the black lead to the breaker arm. The light will go out when the points open. The spring scale should read between 15 and 32 ounces when the points open. If the tension is low, disassembly of the points will be necessary in order to correct it. If disassembled, the points must be redressed because it will be impossible to assemble them in their original relation. The dressing operation is covered in a later paragraph of this manual.

(8) After thoroughly cleaning and inspecting the

assembly it should be relubricated by applying three drops of S.A.E. No. 60 oil to the bottom felt of the cam follower and two drops of the same oil to the upper part of the felt. (See figure 21) The assembly should then be allowed to remain undisturbed for at least 15 minutes before operating it in a distributor. This interval of time will allow the oil to penetrate the felt and minimize any tendency for the oil to be thrown off during operation.

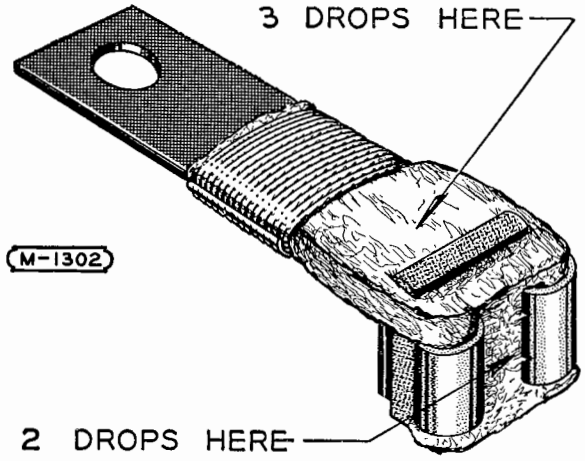


Figure 21
Lubrication of Cam Follower

(9) For dressing the points, the No. 11–1248 dressing kit is used. This consists of a holding block, a special file and a stone. The block is shown in figure 22.

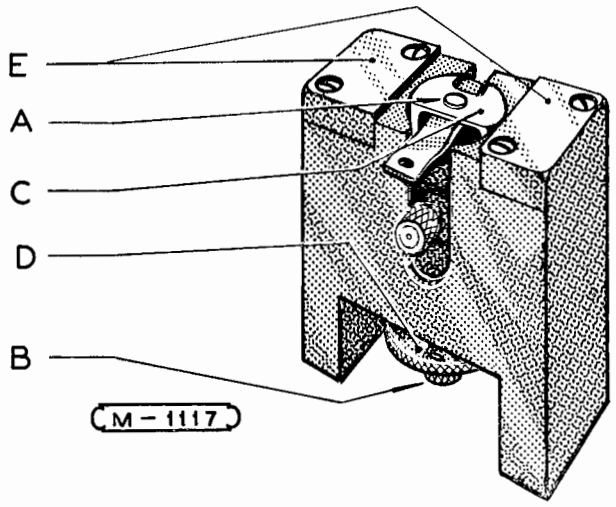


Figure 22
Contact Point Dressing Block

(10) To install the point in the dressing block, first back down screw "B" until the point can be placed under the strut "C", with the platinum point up through hole "A". (See figure 22). Then take up on screw "B" until the point is held firmly in place up against the strut. Do not use too much force on screw "B", or you may distort the parts. The point will be rough dressed with a special fine file (tool No. 11-1256). Rest the file across the two guide shoes "E", and adjust knurled nut "D" until there is just a very slight pressure of the point against the file. Now move the file back and forth, holding it firmly in place against the guide blocks, until the surface of the point is clean.

(11) When dressing a set of points which have been rejected due to pits and mounds, do not try to completely remove the pit. File the point only enough to smooth and flatten all the surface around the pit. This will usually leave plenty of contact area around the hole as shown in figure 23 and the assembly will perform in the same manner as a perfect point. It is obvious that if the pit were deep, most of the platinum pad might be removed if an attempt were made to entirely eliminate the pit by filing.

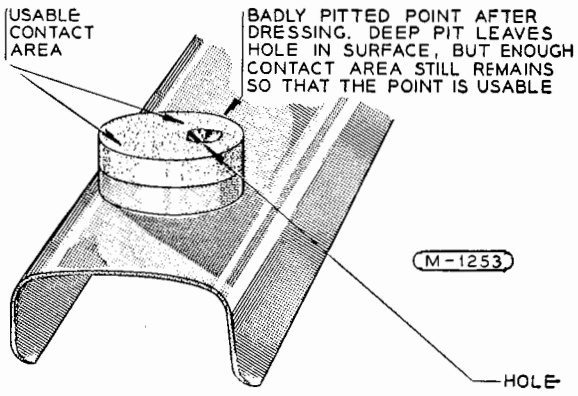

USABLE CONTACT AREA
BADLY PITTED POINT AFTER DRESSING. DEEP PIT LEAVES HOLE IN SURFACE, BUT ENOUGH CONTACT AREA STILL REMAINS SO THAT THE POINT IS USABLE
M-1253
HOLE

Figure 23
Pitted Point after Dressing

(12) When dressing the mounded point, the mound must be entirely filed off. The surface of this point should be perfectly smooth and flat to provide the largest possible contact area against the other point which now will have a slightly decreased area due to the remaining pit.

(13) It is not necessary to obtain a mirror finish on the contact surfaces when completing the dressing operation. Only a few strokes of the stone are required to remove any ridges or burrs left by the file. The most important factor is to have the points flat so that they will provide satisfactory contact area when assembled.

(14) After dressing the points, check the thickness of the point itself with the No. 11–1871 gage as outlined in a preceding paragraph. This will show whether there is still enough platinum on the point to last until the next overhaul.

(15) If the points were disassembled in order to correct low spring tension, it is recommended that the correction be made by installing a new mainspring. However, by the exercise of proper care and judgment many operators are making this correction by bending the spring slighly. If this is done, it is advisable to bend the spring with the fingers, in order to avoid concentrated stresses which might weaken the spring if it were bent sharply with pliers. Usually it only requires a very slight bending to correct the tension so that it is within required limits.

Caution: *Should it be found that the spring was bent too much, as evidenced by excessive tension when*

checked after assembly, do not attempt to correct the tension further by bending the spring a second time. Discard the spring and use a new one.

(16) Use the No. 11–2601 assembly tool when assembling the component parts of the breaker. (Figure 24 shows the order of assembly of the various breaker parts.) In doing this the operator should strive to obtain full contact area between the point surfaces. In a practical sense however, full contact area is often difficult to obtain since it requires both perfect squareness and perfect flatness of the points. In practice, the assembly is acceptable if there is about 2/3 of full contact area, provided the contact is on the side away from the cam follower block. Contact area can be checked by holding the assembled breaker toward the light and observing whether the

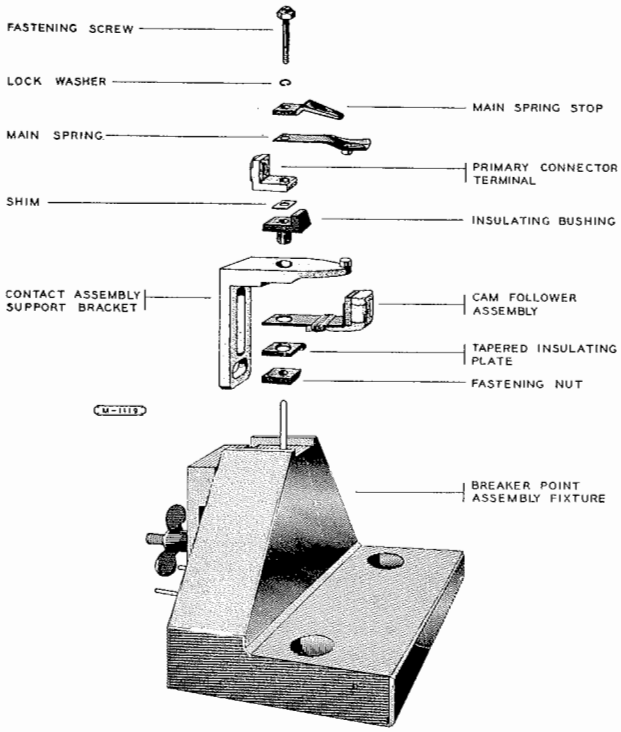


Figure 24
Assembling the Pivotless Breaker

light can be seen between the point surfaces as shown in figure 25. At final assembly, the securing screw which holds the breaker parts together should be tightened to a torque value of 18–20 pound-inches, using the No. 11–1681 torque wrench.

(17) Inspect both of the ball bearings. They should run free and should have no side play. If they do not meet these requirements they should be replaced. Do not clean these bearings in a fluid. Check each bearing for a slip fit on the distributor shaft.

(18) The two cams must be inspected carefully for scoring. Run your fingernail along the cam surfaces. You can feel any scratches or scores easily this way.

(19) Molded bakelite distributor fingers should be inspected for cracks or breaks. If any appear, discard the finger and use a new one. Inspect the carbon brushes. When compressed so that the end

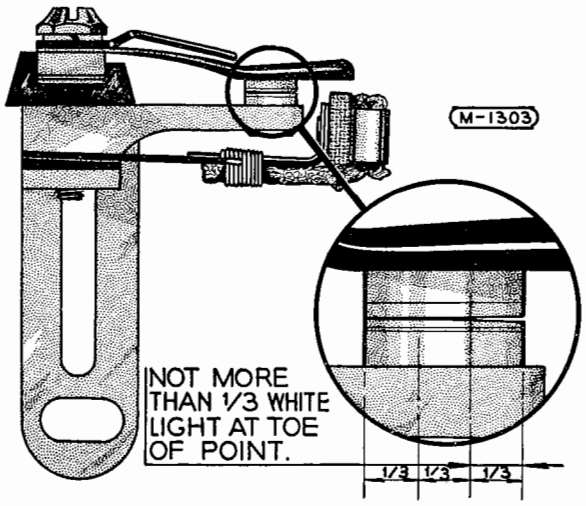


Figure 25
Checking Point Contact Area

of the brush is .047″ from the brush insert in the finger, the spring tension as measured with the No. 11–2731 gage should be between 18 and 30 ounces. (See Figure 26.) To make this measurement, start by placing a mark .047″ (3/64″) from the end of the brush. Use a sharp pencil. Then, using the No. 11–2731 gage as shown in Figure 26, compress the brush until the pencil mark is just level with the flat surface of the brush socket insert in the finger. With the brush compressed to this position the tension as indicated by the spring scale should be 18 to 30 ounces. (See Figure 26.)

Note: *Carbon brushes in the new execution aluminum fingers should have a tension of 24 to 30 oz.*

Caution: *The carbon brushes in the distributor finger are easily broken when in the extended position. Therefore do not tamper with the brushes or "SNAP" them with the finger. To try the brushes for free action in their sockets they should be gently compressed and then released SLOWLY and CAREFULLY. Snapping the brush by releasing it suddenly is almost certain to break the carbon.*

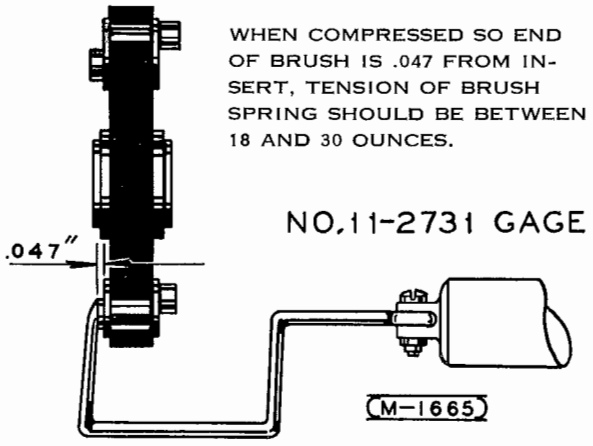

WHEN COMPRESSED SO END OF BRUSH IS .047 FROM INSERT, TENSION OF BRUSH SPRING SHOULD BE BETWEEN 18 AND 30 OUNCES.
NO.11-2731 GAGE
.047″
M-1665

Figure 26
Measuring Tension of Distributor Finger Carbon Brush

(20) If the carbon brushes are worn excessively or cracked, chipped, or otherwise unsatisfactory, replacement should be made.

(21) To replace a carbon brush, touch the center of the soldered (rear) end of the brush with a hot soldering iron just long enough to loosen the old brush and allow it to fall out. Carefully coat the copper plated portion of the new brush with solder, using a non-corrosive flux such as rosin or Day flux. Do not allow any flux to reach the large diameter section of the brush. Remove all excess solder from the brush after coating. Place the new brush in its socket and using a hot iron, solder the brush into the looped inner end of the spring. Do this solder job quickly, to avoid excessive heating of the spring.

(22) After soldering, check the new brush for free action by compressing it with the finger and then slowly releasing it. DO NOT ALLOW THE BRUSH TO SNAP AS THIS WOULD BREAK IT.

(23) Check the free length of the brush (the amount the brush extends out from the molded surface of the finger). The brush should not extend out more than 7/32″ from the molded surface of the finger. If the free length is greater than this, the brush may not be properly seated in the spring. Reheat the solder joint, at the same time pressing the brush firmly against the spring in order to seat it fully. After the soldering is completed, make sure there is no flux or excess solder on the brush or working coils of the spring.

(24) New brushes must be surface-dressed before being placed in operation, to insure proper contact and smooth operation against the collector rings or distributor segments. The No. 11–3210 surfacing tool is used for this operation. To surface-dress the brushes, engage the finger over the projecting shaft of the No. 11–3210 tool on the side marked "rough lap". Then slide the finger down until the brushes rest against the sandblasted surface of the abrasive block, and exerting a light pressure on the brushes, turn the finger through one complete revolution. Remove the finger and inspect the contact surface of the brush. If the entire contact surface has been ground smooth and flat by the action of the roughened block, the brush is satisfactory. If any part of the surface was not touched by the block, repeat the one-revolution grinding operation. When a satisfactory surface has been obtained, repeat the same operation using the "finish lap" side of the abrasive disk.

(25) Should it happen that only one brush was replaced in the finger, the operator should attempt to avoid grinding the original remaining brush when surfacing the new one. This will preserve the original well-worn-in surface of the original brush. Ordinarily it will be found that the new brush is slightly longer than the one which has been in service, enabling the new one to be properly ground without having the old one contact the abrasive block. If this should not be the case, the used brush can be compressed and a small piece of sheet metal inserted between the coils of its spring to hold it up out of contact with the block during the grinding operation.

(26) Check the compressed length of each new brush after it has been surface-dressed. When the brush is fully compressed so its contact face is flush with the surface of the finger insert, the distance from the face to the most extreme projecting part of the spring on the opposite side of the finger must not exceed .594 (see figure 27).

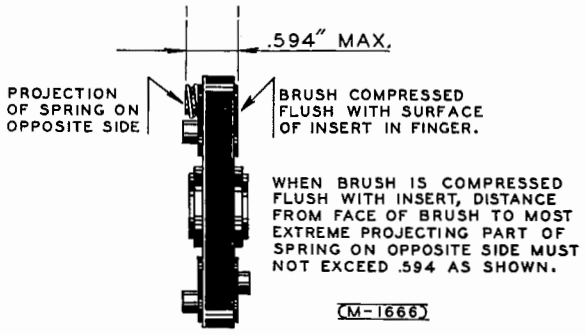

.594″ MAX.
PROJECTION OF SPRING ON OPPOSITE SIDE
BRUSH COMPRESSED FLUSH WITH SURFACE OF INSERT IN FINGER.
WHEN BRUSH IS COMPRESSED FLUSH WITH INSERT, DISTANCE FROM FACE OF BRUSH TO MOST EXTREME PROJECTING PART OF SPRING ON OPPOSITE SIDE MUST NOT EXCEED .594 AS SHOWN.
M-1666

Figure 27
Checking Compressed Length of Newly Installed Carbon Brush

(27) With the condenser tester (tool No. 11–1767) check the condensers electrically. (See figure 28)

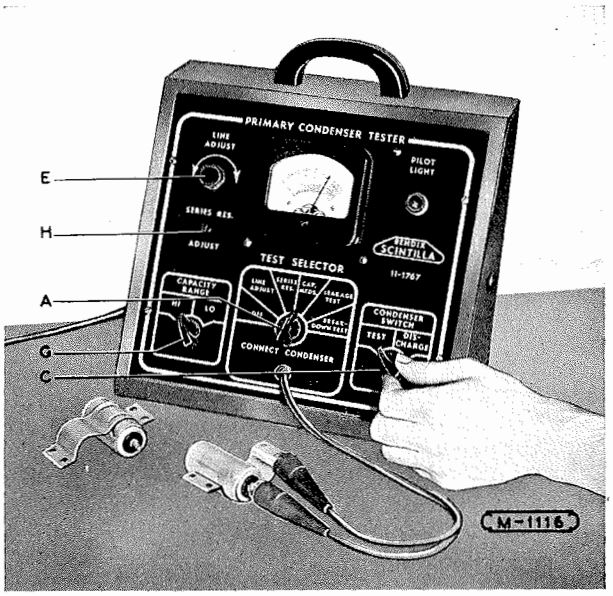


Figure 28
Condenser Tester in Use

(28) Connect the tester to a 110 volt 60 cycle AC source. Keep the test leads separated and turn selector switch "A" to "Line Adjust". Wait a few moments for the tester to warm up. Now hold condenser switch "C" in the TEST position and turn the LINE ADJUST knob "E" until the needle is exactly on the small SET mark on the meter scale. Now turn selector switch "A" to SERIES RESISTANCE position. Clip the two test leads together, and with the switch "C" held at TEST, adjust the SERIES RESISTANCE screw "H" until the needle is once again exactly over the SET mark on the meter scale. The tester is now ready for use.

(29) Connect the leads to a condenser, one to the terminal and one to the condenser bracket. Put the

selector switch "A" in SERIES RESISTANCE position, turn condenser switch "C" to TEST position, and note the reading on the top scale of the meter. The condenser is O. K. if the needle falls within the GOOD section of the scale. If it does not, check to see that the leads make good electrical contact with the condenser and repeat the test. Turn the condenser switch "C" to DISCHARGE for a moment after each test. Now turn the selector switch "A" to CAP. MFDS. position. Turn the condenser switch "C" to TEST and the capacity switch "G" to HI. The condenser should show at least .4 mfds. Next, turn the condenser switch "C" to discharge for a moment, and then turn the selector switch "A" to LEAKAGE TEST. Now heat condenser in an oven to 190 degrees plus or minus 10 degrees F. (88° plus 5° minus 6° C.) Reconnect the leads and turn the condenser switch "C" to TEST. The needle should in about thirty seconds return to no reading at the left end of the leakage scale. If it stays in the yellow or green sections, the condenser is still usable. If the hand stops in the red section the condenser is no longer fit for service. While the condenser is still heated, after turning the condenser switch "C" to DISCHARGE for a moment turn the selector switch "A" to BREAKDOWN TEST. Hold condenser switch "C" in TEST position for about fifteen seconds. The needle should stop somewhere in the O. K. section of the bottom scale. If the meter has given satisfactory readings for all tests, the condenser is acceptable for service. If not, reject it and use a new one.

d. Reassembly

(1) Begin by assembling the large bearing and the lower cam on the shaft. The bearing may be assembled either side up. When assembling the cam, be sure the directional arrow points in the clockwise direction as viewed from the drive (splined) end of the shaft. Install the key for the upper cam by tapping it into position with a mallet. Assemble the upper cam, small bearing, a new eared lock washer and the hexagon nut. Hold the shaft by means of an end wrench applied on the flats provided, and tighten the hexagon nut. Then lock by bending up the ears of the ear lock washer.

(2) Press the complete assembly of shaft, bearings and cams, into the housing. Use fiber or wood blocks against the ends of the shaft and housing to protect the parts against damage.

(3) Secure the retainer for the large bearing with its three screws and ear lock washers.

(4) Assemble the collector plate into the housing. Observe the dowel pin which locates the plate in position and make sure this pin engages the corresponding hole before attempting to tighten the securing screws. Use new ear lock washers on all screws.

(5) Assemble the distributor finger to the shaft, making sure the arrow on the finger points in the clockwise direction as viewed from the drive end. (See Figure 29.)

(6) Slip the rubber sealing washer over the shaft and engage it in its groove. Apply a small amount of grease over shaft and washer and install the spacer sleeve.

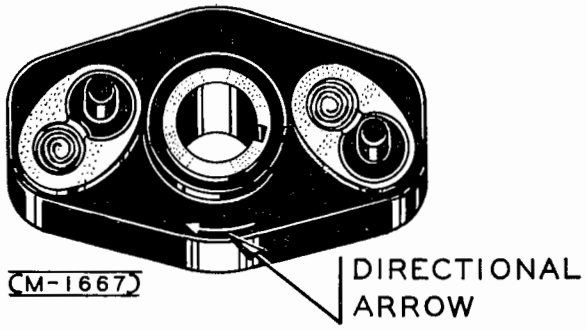


Figure 29
Directional Arrow on Distributor Finger

(7) Temporarily place the original shims in position and assemble the lapped washer, ratchets and drive coupling parts. Tighten the drive shaft nut finger tight.

(8) Check the distance from the mounting surface of the distributor housing to the sealing surface of the lapped washer, using the No. 11–3213 gage bar and No. 11–3214 gage. If the gage plunger is between the upper and lower steps on the gage body, the original shims are satisfactory. If the plunger is above the high step, remove shims, if below the low step, add shims until the gage plunger lies between the two steps. If No. 11–3214 gage is not available, the shims may be checked with a depth micrometer and gage blocks. The sealing surface of the lapped washer must be 1.570±.003″ above the mounting surface of the flange as shown in figure 30.

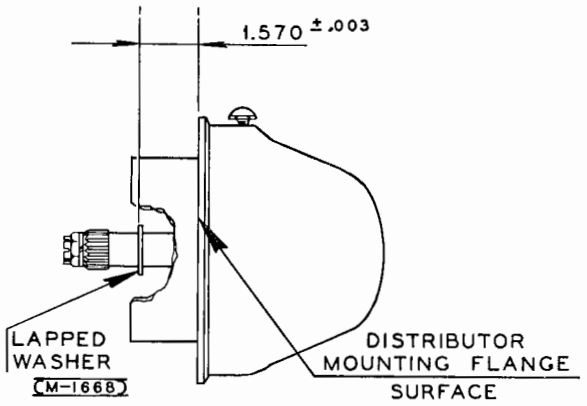


Figure 30
Relation of Lapped Washer to Mounting Flange

(9) After installing the correct amount of shims, tighten and cotter pin the drive shaft nut.

(10) Install the breaker plate and primary leads. Connect a timing light across the No. 1 breaker, and turn the distributor until a straight edge, held against the timing step on the end of the shaft, lines up with the No. 1 timing mark on the top of the distributor as shown in Figure 9.

(11) Loosen the two screws which secure the No. 1 breaker to the breaker plate, and, by means of the adjusting eccentric, adjust the No. 1 breaker to the position where the contact points are just opening as determined by the timing light. Tighten the breaker

securing screws and recheck to make sure the points break at the instant the straight edge lines up with the mark. Readjust breaker if necessary.

(12) Then turn the distributor to the position where the straight edge lines up with the No. 2 timing mark, and, after connecting the timing light across the No. 2 breaker, adjust the latter to open at this position in the same manner as used for No. 1 breaker.

3. THE HARNESS ASSEMBLY & PRIMARY LEADS

a. Disassembly

(1) Since there is only low voltage wiring in the harness, it is not anticipated that a routine disassembly will be necessary at each overhaul period.

(2) For this reason, harnesses turned over to the shop for overhaul or repair, should be electrically tested to determine the general condition of the wiring before specifying the nature of the treatment to be given the harness. The procedure for electrically testing and inspecting the harness is covered in paragraph 3**c**. of this section.

b. Cleaning

(1) Before removing the protector caps and covers, carefully wipe the harness free of all external oil and dirt, using a clean cloth dampened in gasoline.

(2) Remove distributor protector covers and clean the segment plate with a cloth dampened in gasoline. With a wooden tooth pick or any similar soft pointed object, clean out the spaces between the segments. Take care not to scratch the surfaces of the segments.

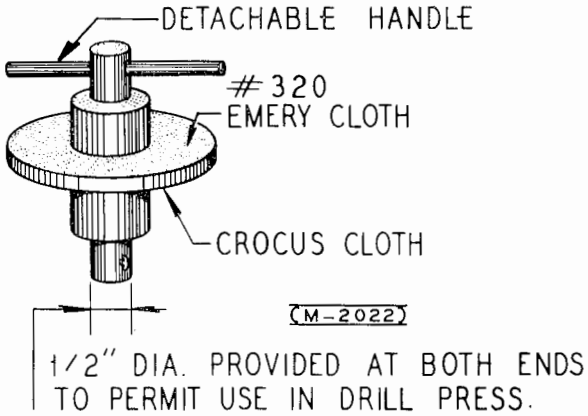


Figure 31

Inspect the segments in the segment plate of the distributor. If they show any roughness, pitting or scoring, they should be refinished. The refinishing operation is performed by means of the No. 11–3249 tool which is shown in Figure 31. The tool incorporates two working faces so that both coarse and fine polishing operations can be performed without changing the abrasive discs which are used for this purpose. As supplied from the factory each tool has a disc of No. 320 emery cloth cemented to one face and a disc of crocus cloth to the other. These grades of abrasive are suitable for all except very seriously pitted plates. In the case of very severe pitting or burning a disc of No. 150 emery cloth should be cut to fit the tool and may be cemented directly over the No. 320 disc if desired, using ordinary rubber cement. For such seriously pitted plates it may save time to remove the plate from the distributor or harness and perform the work with power driven equipment. The No. 11–3249 tool is provided with a ½ in. diameter section at each end to permit the tool to be chucked in a drill press for use in such an application. For plates having only the usual slight scoring and for those which have previously been treated with No. 150 emery cloth, the No. 320 abrasive side of the disc is used to remove all scratches and provide a uniformly polished surface over all the segments. Upon completion of this operation with the No. 320 cloth, the edges of the slots between the segments, should be chamfered, using a fine oil stone. A hard Arkansas oil stone about ⅜ in. square is satisfactory for this operation and the stone should not be more than one or two inches long; otherwise it will interfere with the segments which are diametrically opposite the slots being stoned and may cause scratching of these segments. The use of the oil stone will turn up a slight burr at the corner of each segment. This must be removed by giving the plate a final light polish with the crocus cloth side of the tool. If it should be found that there are pits which extend below the level of the molded surface of the segment plate, refinishing should not be attempted. Such plates are burned too severely for repair and should be scrapped.

> **Note:** *If No. 150 emery cloth is cemented over the No. 320 cloth as suggested above, the latter can be removed from the tool by simply peeling it away with the fingers. Any remaining rubber cement can then be rolled off and this latter process will also serve to clean the No. 320 cloth of any metallic particles which may have become imbedded in it.*

c. Inspection & Repair

(1) Electrical testing of the complete harness assembly with the leads attached is accomplished with the No. 11–3030 tester, which enables both high voltage leakage and low voltage continuity tests to be made.

(2) Connect the metal case of the No. 11–3030 tester to a good ground such as a water pipe. Be sure the toggle switch on the panel is in "OFF" position then plug the tester lead cord into a receptacle delivering 115 volts 60 cycle alternating current. See that the voltage control (the large knob at the left of the panel) is turned to the LEFT as far as it will go. Place the large toggle switch at the lower left corner of the panel in the "CONTINUITY" position. Turn on the tester and plug the test leads into the jacks marked "CONTINUITY" and "GROUND" at the lower right hand corner of the panel. Touch the two test leads together to check the operation of the test lamp. When the test leads are touched together the indicator lamp in the panel should light.

(3) Connect one test lead to the distributor end of the wire which is to be tested and the other test lead to the manifold outlet or magneto conduit connector pin which is at the other end of the wire. Figure 5 shows the connection of the wires inside the manifold.

(4) As a means of making the test systematically, it is suggested that the operation be started with the right distributor base. Touch one lead of the tester to the terminal button on the side toward the left distributor base, and the red lead to the connector pin "B" in the magneto outlet. The correct connections are determined from the table (figure 5). When the connection is made, the lamp in the tester should come on, indicating a satisfactory circuit through the harness. Be sure to recheck all your connections if you should encounter an open-circuited wire, to make sure that the tester is correctly connected.

(5) Proceed in the same manner to test all the manifold wires in the right distributor base, in accordance with the table (figure 5). Check the other terminal button to pin C; No. "1" segment to pin "A" in No. 7 outlet etc., until all segments and contacts have been checked.

Caution: *When applying the test-lead terminal to the segments, the terminal should be placed against the edge of the segment, not directly against the contact face where the carbon brushes travel.*

(6) For the high-voltage test of the harness insulation, connect the test lead from the "GROUND" jack of the No. 11–3030 tester to the metallic manifold of the harness. Push the large toggle switch on the panel to the "1000 VOLTS" position. DO NOT TOUCH THE METAL TERMINAL OF THE HIGH VOLTAGE TEST LEAD.

Caution: *This tester is capable of delivering a severe shock if the operator accidentally touches the high tension lead while the power is on. Therefore the customary precautions usually observed in connection with high voltage instruments should be taken in using this tester.*

(7) Turn the voltage control of the tester to the right until the meter needle is exactly over the "1.0" graduation at the right hand end of the meter scale. The tester is now delivering a 1000 V.D.C. test potential across the lead terminals.

(8) Holding the high voltage test lead by its insulated handle, check each wire in the harness for leakage. This is done by touching each of the distributor segments and contact buttons in turn with the high voltage terminal of the tester, and noting the meter reading for each wire. Should the meter read less than .8 on any wire, the insulation of that wire is defective and the harness will require further investigation. The .8 milliampere reading on this tester corresponds to an insulation resistance of approximately 1 megohm.

Caution: *When applying the test lead terminal to the segments, the terminal should be placed against the edge of the segment, NOT DIRECTLY AGAINST THE CONTACT FACE WHERE THE CARBON BRUSHES TRAVEL. This will prevent the formation of any electrically burned areas in the carbon brush path.*

(9) Should any wire show a discontinuity or a low insulation resistance, first check the segments themselves to see that they are not shorted out by carbon dust or an accumulation of conducting particles which might cause lowered insulation resistance when checked with the tester. Also check the connectors at the back of the distributor block. These are accessible after loosening the screws which screw the block in the distributor base, and lifting the block slightly. Notice whether all terminals are tight and secure, and whether they are all spaced sufficiently from adjacent terminals.

(10) If the trouble is not located during these checks, remove the forked primary lead from the manifold and check the connector receptacles and pins of all outlets to see whether they are fouled by any small chips or dust which might cause the lower insulation resistance.

(11) Conduct an electrical test on the forked lead separately. For the continuity test, check from contact socket "A" in the four-pin electrical connector at the manifold end of the lead to contact socket "A" in the elbow end of the lead. In like manner check from the four-pin connector socket "B" to "B" in the elbow end of the lead; four-pin connector "C" to "B" in the straight end of the lead, and four-pin connector "D" to "A" in the straight end of the lead. The high voltage test is conducted by setting up the 11–3030 tester in the same manner as previously described for the test of the complete harness. Then connect the ground side of the tester directly to the lead shielding and touch the high voltage lead in the tester in turn to each of the sockets "A", "B", "C" and "D" of the four-pin electrical connector at the manifold end of the lead. Should the lead fail to pass the electrical test, rewiring of the lead must be accomplished. This procedure is described in a later paragraph of this section.

(12) If the lead is disclosed to be satisfactory on test, repeat the test on the related circuit in the harness with the lead detached. If the trouble is still evident in the harness, partial or complete rewiring of the harness itself may be necessary to correct the trouble.

(13) Disassembly of the harness should not be undertaken except at locations where adequate facilities are available for replacement of parts as necessary to reassemble. Owing to the design of the outlet connectors on the manifold, these parts cannot be removed without permanently damaging the rubber insulating material of the molded insert. For this reason complete replacement of the outlet insert must be made whenever an outlet is removed for rewiring.

(14) When replacing a harness outlet connector, only the four wires serving the particular outlet being replaced need be loosened from the distributor block. Determine from the table (figure 5) which wires are connected to the outlet which it is desired to replace. Disconnect these wires in the distributor bases, and tie a piece of stout cord to each wire terminal so that the wires will not be "lost" inside the conduit when they are pulled through as the outlet connector is withdrawn.

(15) The outlet connectors are a tight fit in the outlet bushings and cannot be withdrawn without permanent damage. Removal can be accomplished by forcing an ordinary corkscrew into the rubber part of the outlet connector. After engaging the corkscrew securely, the inner part of the connector can be withdrawn. The new connector can then be soldered to the original wires in the same manner as the old con-

nector. Be sure that each wire is soldered to the correct connector insert in the rubber insulating block.

(16) When soldering the wires to the inserts in the soft rubber grommet, the work must be done quickly in order to avoid damage by the application of excessive heat to the rubber. The use of soft solder, and a properly tinned iron will materially reduce the possibility of damage in this respect. Under no circumstances should any acid flux be used for the soldering operations. Use only rosin base flux. Only a small quantity should be required, as the connector pins are plated to facilitate the soldering.

(17) After soldering, the connector parts must be pushed back into the outlet. The No. 11–2879 tool is used for this purpose. First, start the rubber part into the outlet bushing by hand, pushing it into place as far as it will go. Then turn the T handle of No. 11–2879 tool to the left far enough to enable the threaded sleeve on the tool to be engaged with the threads on the manifold outlet. Turn the tool until the keyway and the pin holes in the pressure block line up properly with the key in the manifold and the pins in the new connector assembly. It may be necessary to turn the connector assembly slightly in order to have the pins and the keyway in the correct position. Then lock the tool in position by means of the clamping nut, and push the new connector into position by turning the T-handle of the tool to the right. As the outlet is pushed into position, take up the slack in the wires in the manifold by pulling lightly on the other ends of the wires in the distributor head. When the engraved line on the pressure block of the tool lines up with the rim of the outlet, the terminal has been pressed in to its required position. Remove the tool and reconnect the wires to the distributor block. Then repeat the electrical test on all wires to make sure the new connections are secure and that none of the other wires were damaged in performing the operations.

(18) If it becomes necessary to replace one wire in a manifold, substantially the same procedure as given above should be followed except that a new length of wire should be soldered to the distributor end of the old wire before the latter is removed, then pulled into position as the old one is pulled out.

(19) Should complete replacement of all wires in the harness be necessary, the following procedure is recommended.

(20) Remove all outlet connectors and both distributor blocks. Pull all the old wires out of the manifold. Wash the manifold thoroughly in a liquid cleaner. Rinse manifold thoroughly in clear gasoline or other easily evaporated solvent, and then dry throughly with compressed air, giving particular attention to the blind ends of the manifold so that no solvent, cleaner or foreign material remains in the manifold tube. Drying the manifold for a few hours in an oven is a good idea if the equipment is available to do this.

(21) The first step in rewiring is to get the necessary "fishlines" run through the manifold so that the wires can be pulled in. The fishlines should be of stout cord since they have to withstand quite a heavy pull. Eleven fishlines must be run from each distributor base—one to each of the nine manifold outlets and one each to the magneto and switch outlets. A good way to get these lines in is to plug up all the outlets except the one on which you are working at the moment. Start the string into the manifold outlet. Now use an air hose with a small nozzle and blow the fishline into the manifold. Since the only outlet for the air is the distributor base, the air will carry the string along with it to the distributor base. You may have to fish for the end of the string with a hooked wire, but a little practice will soon make it a simple procedure. When the string has been pulled in, tie the two ends together so that the string cannot come out and also to identify the two ends.

(22) If compressed air cannot be used for this purpose it is possible to fish the lines through the manifold with two pieces of wire. Push one wire through the manifold by hand and hook it out with another piece of wire when it passes the desired outlet. Put in all the fish lines, before you begin to put in any wires.

(23) The table in figure 5 shows the correct connections for the wires from the distributors. The wire used is stranded No. 18 gage, rubber covered and fabric sheathed. Wire with red tracer is used for all the left distributor leads. Wire with green tracer is used for the right distributor.

(24) Cut a pair of wires for each of the manifold outlets in accordance with the table of wire lengths. As an example, for the number two outlet cut a piece of red wire 56 inches long and a piece of green wire 26 inches long. Double each of these pieces of wire in its exact center. Push the ends of both wires through a new rubber grommet and solder the ends of the red wire to pins A and D of a new connector assembly and the ends of the green wire to pins B and C. When the soldering is finished, push the rear grommet up tightly over the connections and the assembly is ready for insertion into the manifold.

Table of Wire Lengths For R-2800 Low Tension Systems

Manifold Outlet Number	*Wire Lengths and Colors*			*Ends Soldered To Connector Pins*
1	Red	40″	Long	A & D
	Green	40″	Long	B & C
2	Red	56″	Long	A & D
	Green	26″	Long	B & C
3	Red	72″	Long	A & D
	Green	38″	Long	B & C
4	Red	86″	Long	A & D
	Green	54″	Long	B & C
5	Red	102″	Long	A & D
	Green	70″	Long	B & C
6	Red	68″	Long	A & D
	Green	102″	Long	B & C
7	Red	53″	Long	A & D
	Green	86″	Long	B & C
8	Red	38″	Long	A & D
	Green	74″	Long	B & C
9	Red	26″	Long	A & D
	Green	56″	Long	B & C
Switch	Red	32″	Long	A & D
	Green	50″	Long	B & C
Magneto	Red	32″	Long	A & D
	Green	50″	Long	B & C

(25) Make up eleven sets of wire and connector assemblies in this manner, for the nine manifold-to-coil outlets, and the magneto and switch outlets.

(26) Starting with the longest wires, pull the wires into the manifold. Locate the fishlines which lead to the particular outlet. Cut these lines and tie the outlet end of the line from the right distributor to the loop in the green wire. Likewise tie the red wire to the line leading to the left distributor. Make sure these knots are secure so they will not slip when pulling the wires through the manifold.

(27) The wires can now be pulled into position by means of the strings. Keep the slack in both wires even by pulling on first one and then the other. A little DC-4 compound rubbed over the wires will make them slide through the manifold more easily. Stop pulling when the connector assembly has been drawn up to the outlet. Do not press the connector into position until all wires have been installed and checked.

(28) After pulling in the two wires as above you will have two loops of wire—one extending out of each distributor outlet. Tie a small tag to each of these loops and mark it with the number of the outlet to identify this loop. Then in the same manner pull in the wires for the other outlets, identifying each one with a tag.

(29) When all the wires are in place, put the distributor block in position. The block locates on dowel pins which will engage only in the correct relation. After the plate has been located correctly, lift it up in vertical position so the connections will be accessible for wiring.

(30) In order to identify the wires for connection to the terminals in the segment plate, it will be necessary to use a timing light or electrical continuity tester. The small tags attached to each pair of wires will identify them so that only the two pins for each pair will need to be checked.

(31) After the wires have been properly identified, cut each individual wire to length so that it will fit properly onto the terminal of the segment plate.

(32) To attach the terminals to the wires, first strip the insulation from the end of the conductor or about $\frac{3}{16}$ of an inch, and slip an insulating sleeve on the wire. Secure a new terminal to the end of the wire by crimping the terminal tightly over the insulation and conductor strands, as shown in figure 32. It may be necessary to cut off the end of the conductor strands slightly in order to properly install the terminal in the relation shown in figure 32.

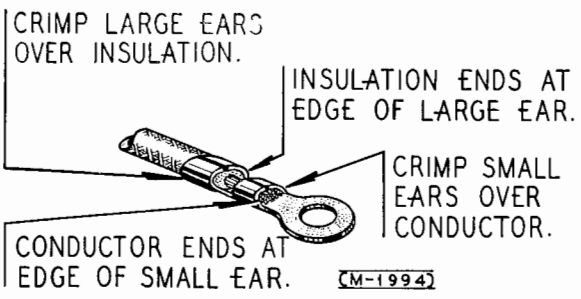

CRIMP LARGE EARS OVER INSULATION.
INSULATION ENDS AT EDGE OF LARGE EAR.
CRIMP SMALL EARS OVER CONDUCTOR.
CONDUCTOR ENDS AT EDGE OF SMALL EAR.
M-1994

Figure 32
Installation of Terminal to Wire

(33) Solder the terminals to the wires. For this operation use only rosin flux solder and avoid an excess. (See Figure 33) Do not, under any circumstances, use an acid flux. After soldering push the insulating sleeve up over the terminals to a location where the sleeve just nicely covers the soldered portion of the terminal.

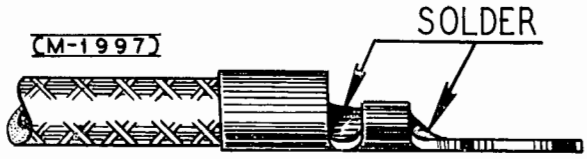


Figure 33
Application of Solder to Terminals

(34) Starting with the segments which are nearest the throat of the distributor (segments number 11 and 13) assemble the wires to the segment plate. When assembling these connections, keep the wires together and close to the plate so that they will fit within the space provided in the distributor base casting. It will be necessary to form the wires into a compact group on both sides of the plate, as shown in figure 34. Two terminals on each primary connection R "and L" must be assembled one directly over the other, as shown in figure 34.

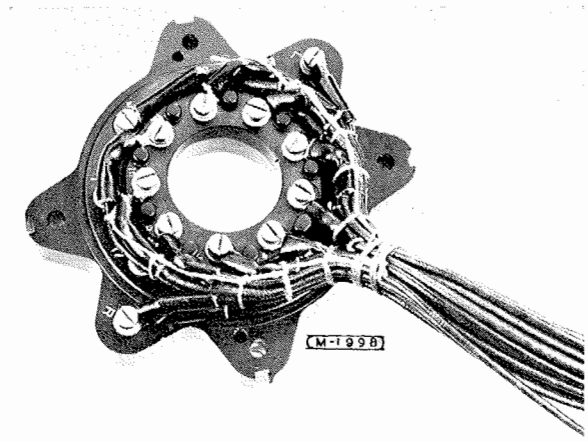


Figure 34
Wires at Back of Distributor Segment Plate

(35) After all wires have been attached, bind the wires tightly in position with electric lacing cord. Cut an 18 inch length of cord for each side of the plate. Start with the L side of the plate and tie number 3 and number 5 wire at a position about ¼ inch clockwise from number 5 terminal. Make the second loop to include numbers 3, 5, 7 and 14, locating this loop just clockwise of number 7 terminal. The third loop should include numbers 3, 5, 7, 9, 14, 16 and the primary wires to terminal L on the plate. A fourth loop should include in addition to the above, number 18 wire and a fifth loop includes numbers 2 and 11 in addition to all the others. The relation of these various loops to the wires on the back of the plate is shown clearly in figure 34. Lace both sides of the distributor segment plate wiring in exactly the same manner. This will bring out two loose ends of the cord at the back of the plate. Then wind both of

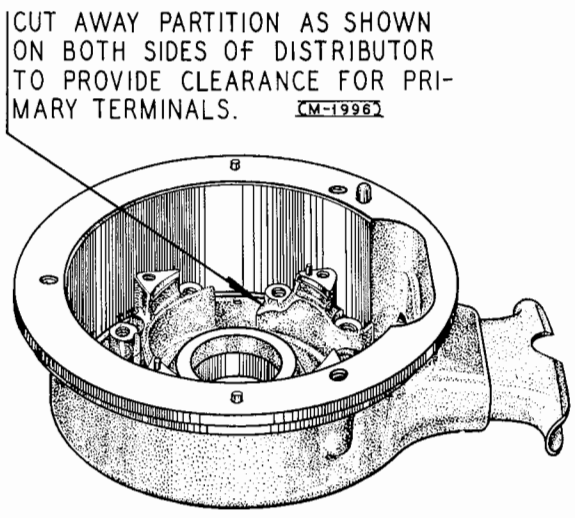


Figure 35
Relieved Casting of Distributor Base

these ends tightly about the wires and tie them tightly to each other.

> **Note:** *If it should be found impossible to fit the laced wires of the segment plate into the space provided in the distributor casting, inspect the distributor casting to determine whether or not it has been relieved, as shown in figure 35. If the distributor casting has not been relieved by the removal of material, as shown in figure 35, it will be necessary to perform this operation. The corner of the partition in the distributor casting may be scraped away with a sharpened screwdriver or chisel to make it conform to the contour shown in figure 35. This should be done on both sides of both distributors.*

(36) When the connections have all been made and checked, push the connectors into the outlets using the No. 11–2879 tool, as previously instructed.

(37) Repeat the continuity and leakage tests on the completed harness after rewiring. If all tests are satisfactory the harness is ready for use.

PROCEDURE FOR OVERHAULING

NO. 10-52566 LEAD ASSEMBLIES

Disassembly

(1) Assemble the small size pin into the handle of the No. 11-3105 connector contact tool kit: By means of this tool exert a firm steady pressure against the contact sockets of the electrical connectors in the ends of the lead until the sockets are pushed back as far as they will go into the rubber inserts.

(2) Insert the curved jaws of No. 11-3276 special pliers into any one of the lead connector shells, between the shell and the rubber insert. Grip the rubber insert firmly with the pliers, and pull it from the shell. A gentle rocking action may help to start the insert from its position in the shell.

(3) If special pliers are not available, cut a piece of safety wire about six inches long and wind it into the shell around the insert of the connector. Wrap the piece of wire twice around the insert and bring the ends out of the keyway of the shell as shown in figure 36. Simultaneously pull and twist the ends of the wire together so that the wire is drawn very tightly around the insert. Then with a firm, steady pull, withdraw the insert from the shell. (See figure 36.)

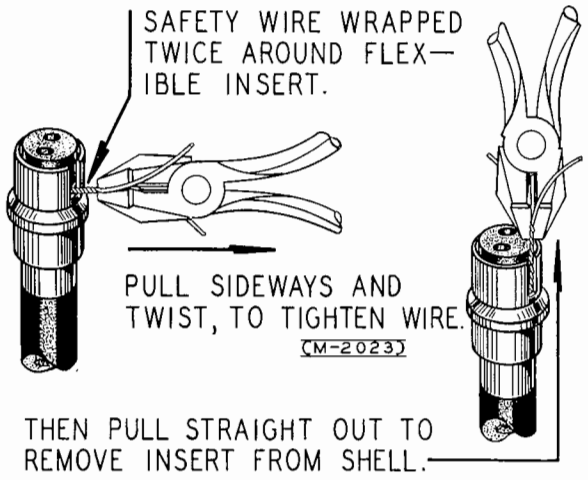

SAFETY WIRE WRAPPED TWICE AROUND FLEXIBLE INSERT.
PULL SIDEWAYS AND TWIST, TO TIGHTEN WIRE.
M-2023
THEN PULL STRAIGHT OUT TO REMOVE INSERT FROM SHELL.

Figure 36
Removing Connector Insert

(4) Remove the inserts from the other two ends of the connector.

(5) A rubber grommet will be found under each insert. Remove each grommet, using a hooked wire as shown in figure 37.

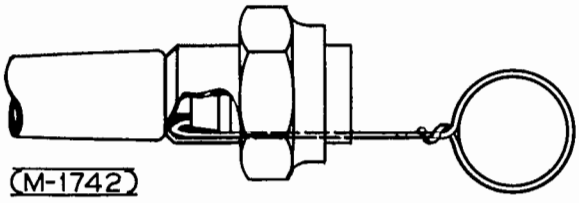


Figure 37
Removing Grommet

(6) After removing the grommets, pull out sufficient wire from the coil ends of the lead assembly to permit cutting off or unsoldering the contact sockets.

(7) After removing the sockets, the wire can be pulled from the manifold end, leaving the conduit empty.

Procedure for Reassembling

(1) Cut two pieces of safety wire about twice as long as the total length of the lead and double them in the center. These wires will be used as fish wires to pull the new wires into the conduit. String these fish wires through both legs of the connector, bringing the looped ends of the wires out at the coil ends of the conduit assembly.

(2) Cut a red wire 44 in. long and a green wire 36 in. long. Double both these wires in their exact center.

(3) Strip the free ends of both of these wires and solder on the four larger sockets which were removed from the coil connections of the old lead assembly.

(4) By means of the fish wires, pull the green wire into the short (or elbow) leg of the connector and the red wire through the long (or straight) leg of the connector. Do not pull the socket contacts into the conduit, pull them only up to within a few inches of the connector shell.

(5) Tie a string about 12 in. long to each of the contact sockets which are soldered to the ends of the wires. The string should be looped about the socket as shown in figure 38.

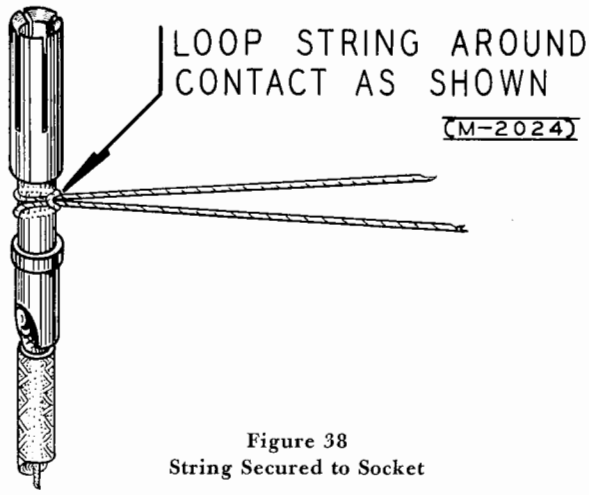


Figure 38
String Secured to Socket

(6) Now cut off just the folded ends of all wires and carefully pull each wire so that the sockets in the coil ends of the lead are just flush with the ends of their respective shells. This adjustment must be made carefully and accurately by pulling on each individual wire, one at a time. It is imperative that the sockets be just flush with the ends of their respective shells. Having the sockets flush with the ends of the shells, cut off the wires flush at the manifold end of the conduit.

(7) Take the manifold end of the lead and pull the red wire which is farthest away from the keyway out about 3 inches. Pull the other red wire out of the manifold end about 1 inch. Pull one of the green wires out at the manifold end as far as it will go. Then pull out the other green wire as far as it will go. Thread the ends of these wires through the four hole grommet in the relation shown in figure 39.

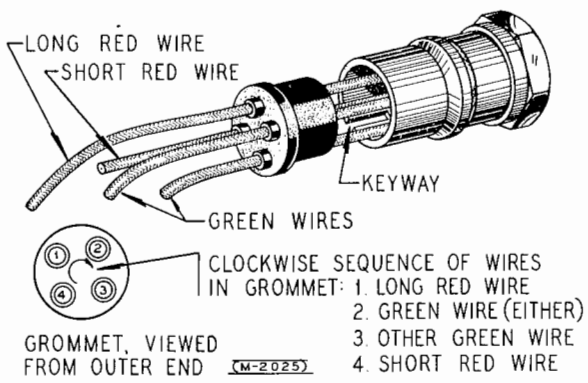


Figure 39
Relation of Wires at Manifold End

(8) Thread a string around the grommet, between the red and green wires as shown in figure 40, and then push the grommet back into the shell of the connector as far as it will go.

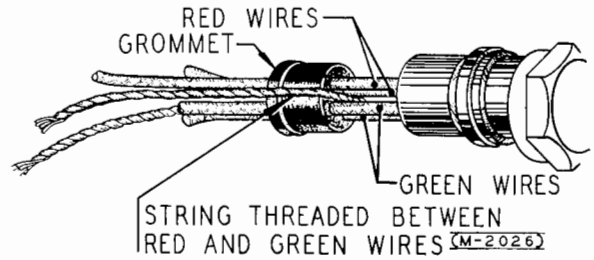


Figure 40
Relation of String to Wires and Grommet

(9) Carefully measure and cut off ¾ inch from the end of each wire. This measurement is very important. The wires will not fit into the conduit unless this dimension is held.

(10) Strip the ends of all wires.

(11) Apply a light coating of DC 4 compound to all wires, being careful not to get any of the compound on the conductor strands.

(12) Insert the long red wire through hole "C" of the insert of the connector.

(13) Solder on the four small socket contacts, one on each of the wires.

> **Note:** *If, due to the shortness of the wires, space is inadequate for proper soldering of the contacts to the ends of the wires, a little more slack wire may be gained for this operation by the following procedure. Wind the entire conduit into a loop about 3 to 4 inches in diameter and secure it in this position with a piece of cord or suitable clamps. With the conduit in this position, it will be found that from ¼ to ½ inch of length of wire can be gained to facilitate the soldering operation. Do not try to crowd the conduit into too small a loop or the flexible loom will be damaged. A loop of about 3 to 4 inches should be correct.*

(14) Push the other three wires, with sockets attached, into position in the insert.

(15) Pull the grommet up to the insert and remove the string. Line up the keyway in the insert with the keyway in the connector shell. Pull the long red wire and its socket back into correct position in the insert.

(16) By a simultaneous process of pushing on the insert and keeping a light tension on the strings which are attached to the sockets at the coil ends of the wires, work the insert and grommet back against the shell of the connector, then, still keeping the wires tight, press the insert into the shell. It will be necessary to use a small piece of dowel rod of a diameter about ⅛ inch smaller than the rubber insert, to fully seat the insert into the shell. The manifold end of the lead is now completely assembled.

(17) It will now be necessary to install the grommets and inserts into the two coil ends of the assembly. This is done with the No. 11–3136 inserting tool and No. 11–3137 needles. First remove all the strings from the connector sockets at the two coil ends of the lead.

Then slip the grommets onto the tapered ends of the needles, making certain that the grommet is in the correct relation as shown in figure 41. Lubricate

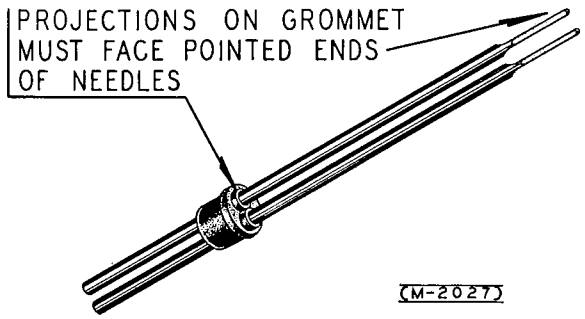


Figure 41
Needles Installed in Grommet

the needles with a little DC4 compound. Engage the needles over the sockets of the connector, then, by means of the No. 11–3137 inserting tool, push the grommet in until it is fully seated in the base of the shell. While holding the grommet in place with the tool, withdraw the needles. Do this at both of the coil end connectors.

(18) Before making final assembly of the inserts into the shell, check, by means of an electrical tester, to make certain that the continuity of the lettered contacts of the connector insert is correct, as shown by the chart in Figure 42. If the connections are not correct in relation to the keyway, they can be made so later by rotating the grommet in the shell. However, the grommet should not be rotated until the tool and insert are installed in position.

(19) Install the insert. This is done by placing the insert on the needles in the same manner as was done with the grommet, placing the tool over the needles and insert, and pushing the insert into position. After the insert has been started into position it can be rotated, if necessary, in order to bring the letter terminals in correct relation to the keyway. It may be found that it is impossible to push the insert all the way into position by hand. If this is the case the assembly may be supported in an arbor press as shown in Figure 43, and, taking care that excessive pressure is not exerted on the parts, the rubber insert may be pushed into its proper location, using a steady, firm pressure.

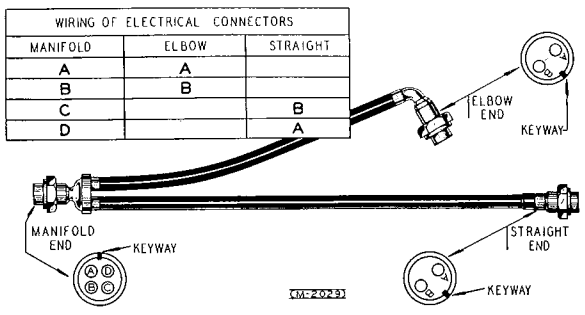


Figure 42
Wiring Chart of Forked Lead

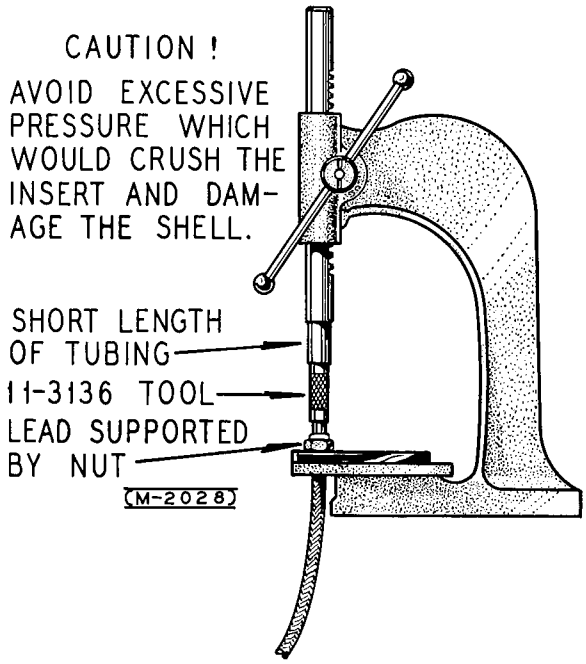

CAUTION !
AVOID EXCESSIVE PRESSURE WHICH WOULD CRUSH THE INSERT AND DAMAGE THE SHELL.
SHORT LENGTH OF TUBING
11-3136 TOOL
LEAD SUPPORTED BY NUT
(M-2028)

Figure 43
Using Arbor Press to Seat Insert

(20) After the insert has been pushed into the shell as far as it will go, remove the needles first, then remove the tool. Upon completion of assembly, a final electrical test should be made as described in paragraph 3 of this Section, to see that the continuity of all wires is correct and that there are no short circuits or grounds in the assembly. Upon passing the electrical test, the assembly is ready to be placed in service.

d. Reassembly

(1) Except for the rewiring and repairing operations covered in paragraph **c.** of this section there is no routine reassembly procedure for this harness.

4. THE HIGH TENSION COILS AND HIGH TENSION LEADS

a. The High Tension Coils

The high-tension coils in the high altitude system are arranged two coils per assembly. The complete double-coil unit is shown in figure 10. There are eighteen of these units, one for each engine cylinder. The two coils are embedded in sealing compound within the sealed metal case. The coil unit cannot be disassembled, and requires no maintenance.

These coil assemblies must be given a sparking test on the test stand as described in Section VII. The sparking test of coils when installed on the engine can be performed with the No. 11–2632 tester as described in Section V.

In addition to the sparking test, a continuity check should be made on both primary and secondary windings in each coil. This may be accomplished with the No. 11–2602 ohmmeter or equivalent. The coils have a primary resistance of 15 to 25 ohms and a secondary resistance of 4000 to 7000 ohms.

b. The High Tension Leads

Each high-tension lead assembly consists of a short piece of metallic-shielded high-tension wire, with connecting fittings. (See figure 10). The leads are permanently assembled and cannot be rewired. No maintenance is necessary, except for electrical testing which should be done at the time of overhaul of the system, or whenever a lead is suspected of causing trouble on the engine.

For the electrical test of the high tension lead, use a high voltage, direct current tester such as the TAKK Model 41, TAKK Model 55, DELCO Model 7244420, BG Model M–652, BG Model M–660, or an equivalent direct current high voltage tester capable of delivering a test potential of 10,000 volts.

Before testing the lead, clean the terminal at each end by wiping with a clean cloth. Inspect the spark plug insulator for cracks or carbon tracking. Use a new insulator if the old one shows any signs of a defect.

Connect the ground lead of the high voltage tester to the outer shielding braid of the lead. Connect the high voltage lead of the tester to the lead conductor at the spark plug terminal. Turn on tester and apply 10,000 volts to the lead. The insulation resistance should be not less than 100 megohms. If the resistance is less than this value, repeat the cleaning operation and test the lead again. Replace the lead if a reading of 100 megohms cannot be obtained.

SECTION VII

TESTING

1. GENERAL

a. In the various sections of this manual a few tests are prescribed for each unit or component part of a unit, which requires test before reassembly. There are also several tests that must be conducted with the main operating parts of the system, properly connected together to be sure that each unit operates properly with the others. These latter tests are performed after mounting the magneto, distributors and coils to a special test stand which permits operation of these parts in correct relation to each other, and allows their output to be observed at a bank of spark gaps provided for this purpose.

b. The recommended test stand is the GREER HYDRAULICS 18-CYLINDER LO-HI TENSION IGNITION TEST STAND, MODEL MG-1 made by Greer Hydraulics, 454 Eighteenth Street, Brooklyn 15, N. Y. Operating instructions are supplied with the test stand.

c. The Harness Assembly is not tested on the test stand. The harness and distributor heads are tested separately for continuity and insulation resistance by means of the No. 11–3030 tester. This procedure is described in paragraph 3 of Section V.

2. THE MAGNETO, DISTRIBUTORS AND HIGH TENSION COILS

a. Lock the test stand drive by the means provided for this purpose, to prevent the shaft turning while the magneto and distributor are being installed.

b. Depress the timing plunger to locate the magneto at its "E" gap position and install it on the test stand in this relation, in exactly the same manner as if you were installing it on the engine.

c. Install each distributor by turning it to the No. "1" firing position and securing it on the test stand in this relation in the same manner as for timing it to the engine. Mount the coils by means of the clamps provided on the test stand frame.

d. Now make all the electrical connections. Connect the primary leads at the magneto. Install the distributor connectors. Connect the primary leads to the coils, and the test set of secondary leads from the coils to the spark gaps.

e. Let the ignition system run for fifteen minutes at 1400 R.P.M. (magneto speed). During this run operate the switch labeled "Shorting-out Switch" several times. At the conclusion of this run stop the machine. Remove the distributors. Inspect the carbon brushes for breakage or burning. Inspect the breaker points for fouling or burning. If there are signs of burning or breakage, return the distributor to overhaul for complete inspection. Possible causes of the trouble are:

(1) Faulty condensers. Check them for capacity.

(2) Cams wrong end up on the distributor shaft. They should be installed so that the arrow engraved on the cam points in the direction of shaft rotation.

(3) Incorrect setting of the breaker points, or accumlation of oil around the points, producing carbon deposits.

(4) Incorrect positioning of the lead on the distributor. This would perhaps cause the impulse to reach the head while the carbon brush was across between two segments.

(5) Incorrect wiring in the distributor or in the harness.

f. The next test is the coming-in speed. Reconnect all electrical connections. The system should spark consistently at 250 R. P.M. The sparks must jump a five millimeter gap with distributors in full retard position. If the system does not spark consistently, check the adjustment of the test stand spark gaps. Figure 44 shows the correct setting for standard 5 mm. test gap electrodes. Be sure the electrodes are properly pointed.

g. If the system does not spark consistently with all gaps correctly adjusted, note the nature of the missing which occurs. If one gap misses consistently, check the corresponding high-tension coil and all primary connectors associated with this coil. See that the related distributor terminal connection is tight. Should the sparking be inconsistent over several gaps it is advisable to check out the entire system for proper continuity and tight connections.

If the above investigation fails to disclose the cause of inconsistent sparking, check the magnetic strength of the magnet by measuring the primary current. To do this, disconnect the magneto from the harness and operate the magneto at 400 ± 10 rpm. Then using ammeter No. 11–1538, check the primary

current of the magneto by connecting one terminal of the ammeter to the magneto housing and the other terminal in turn to each of the four contact pins in the magneto output lead. With the magneto operating at 400 rpm, each of the coils should deliver a minimum of 2 amperes primary current as measured with the No. 11–1538 ammeter. If any coil fails to deliver the required primary current, it is possible that the magnet requires recharging. If so, it should be done in accordance with the procedure given in Section VI. In connection with this test it should be noted that the primary current readings obtained for the No. 1 coils should be somewhat near the same, and likewise the readings obtained for the No. 2 coils should be similar. Should it happen that there is a wide variation in the readings obtained at either the No. 1 or No. 2 coils of the magneto, it is an indication that perhaps one coil may be defective or may be improperly seated to the pole shoes of the magneto. Therefore if a considerable variation is found to exist between the two coils at either the No. 1 or No. 2 ends of the magneto, an investigation should be made to see whether the low-reading coil is properly seated. If the coil is fully seated a new coil should be tried before disassembling the magneto for recharging of the magnet.

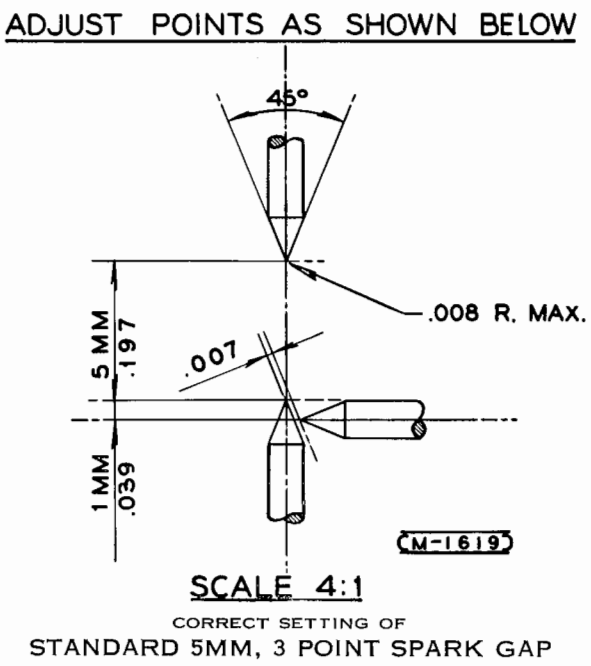


Figure 44

SECTION VIII

SERVICE TOOLS REQUIRED

1. Line Maintenance Tools

Tool No.	*Name*	*Use*
11–851	Timing Light	To check timing of distributor.
11–2632	Tester	To check system.

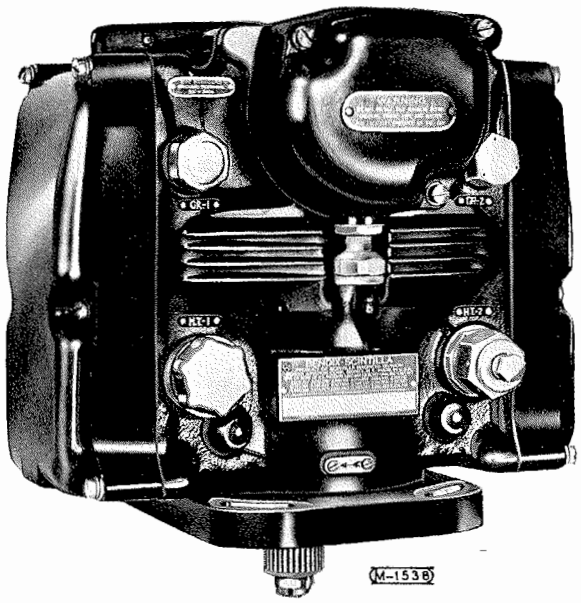
2. Overhaul Tools

11–1239	17 Tooth Spline Wrench	For distributor drive coupling.
11–1248	Contact Point Dressing Kit	For dressing contact point surfaces.
11–1488	Magnetizing Adaptor Set	For charging the magnet.
11–1523	33 Tooth Spline Wrench	For magneto drive coupling.
11–1538	Ammeter	To check magneto primary current.
11–1681	Tension Wrench	For contact point assembly screw.
11–1767	Condenser Tester	To check condenser.
11–1871	Gage	To check thickness of platinum pad on contact points.
11–2601	Assembly Tool	For assembling the breaker parts.
11–2602	Ohmmeter	To check resistance of coil windings.
11–2731	Gage	To check tension of carbon brush, and breaker main spring.
11–2879	Inserting Tool	For installing inserts to manifold.
11–3030	Tester	To check wiring continuity and insulation.
11–3105	Tool Kit	For servicing electrical connectors.
11–3136	Insert Tool	For servicing electrical connectors.
11–3137	Needles	For servicing electrical connectors.
11–3210	Surfacing Fixture	To smooth newly installed carbon brushes.
11–3213	Gage Bar	Used with 11–3214
11–3214	Gage	To determine correct shimming of oil seal washer.
11–3276	Special Pliers	To remove inserts from connectors.
11–3249	Refinishing Tool	For refinishing distributor segments.
11–3281	Split Ring	Used with 11–1488 to charge magnet.

SERVICE INSTRUCTIONS

BENDIX-SCINTILLA AIRCRAFT MAGNETOS

Types DF18RN, DF18LN



Type DF18LN Magneto

SCINTILLA MAGNETO DIVISION
BENDIX AVIATION CORPORATION
SIDNEY, NEW YORK, U. S. A.

PRINTED IN U.S.A.

FORM L-131-1

Magneto Type	Basic Assembly No.	Used on engine type
DF18RN	10-33110	P&W Double Wasp R-2800
DF18LN	10-33275	P&W Double Wasp R-2800

Explanation of Magneto Type Designation

"D"	Indicates a double type magneto (one double magneto together with two separate distributor assemblies are required to provide dual ignition for an engine.)
"F"	Indicates flange mounting.
"18"	Indicates that the magneto will accommodate an eighteen cylinder engine.
"R" or "L"	Indicates rotation of magneto as viewed from the drive end ("R"—Right Hand Rotation or Clockwise, "L"—Left Hand Rotation or Anti-clockwise).
"N"	Indicates the magneto is of Scintilla manufacture.

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SECTION I

GENERAL DESCRIPTION

The Type DF18RN and DF18LN magnetos are double, four-bolt-flange-mounted, eighteen cylinder magnetos designed for vertical mounting on the nose section of the engine. These magnetos employ the principle of the rotating magnet and the stationary coil, which is characteristic of all Bendix-Scintilla magnetos. Their distinctive feature is the provision of true double ignition from a single unit. The two types are identical in appearance and general design except for internal details which are necessarily different for the different rotations.

The rotating magnet is of eight pole design, producing eight sparks per revolution. Since nine sparks are required per revolution of the crankshaft in eighteen cylinder engines, the magneto is driven at 1-1/8 engine crankshaft speed. The magnet turns on two ball bearings, one in the mounting flange, and the other in the housing, just below the bevel gear compartment. (See cross-sectioned view on Service Chart).

Two separate coils are employed to serve the two sets of spark plugs in the engine cylinders. The high tension current from the two coils within the magneto is conducted by means of external cables to two separate distributors, each driven independently of the magneto at one-half engine crankshaft speed. Individual high tension cables then carry the current to the spark plugs.

Two pivotless type, high speed breaker contact point assemblies are used, each being connected to one of the coils in the magneto. The breaker assemblies are actuated by separate cams.

The cams are secured to the opposite ends of a transversely mounted shaft in the upper part of the magneto. Vernier adjusting ratchets are provided for accurately setting the cams when reassembling the magneto after overhaul. Each cam has eighteen lobes, which are ground at unequal intervals to compensate for the slight characteristic top-dead-center variations of each piston on radial engines. This type of cam is known as a "compensated" or "evenfiring" cam. The cam lobes are spaced so as to open the contact points at the exact full advance firing position of each piston. On the magneto, however, the "E" gap* of course varies slightly for each spark. To enable correct timing of the cam, the lobe for firing No. 1 cylinder is marked with a dot (See Service Chart). This lobe is also the No. 1 lobe of the cam.

A step is provided on each cam for timing purposes, when adjusting the contact points. It should be noted that the contact points are always set to open when a straight edge placed against the cam step, lines up with the mark which is inscribed on the breaker plate under the cam. The contact points ARE NOT SET FOR ANY FIXED CLEARANCE. (See Service Chart).

The cross shaft, upon which the cams are mounted, turns on two ball bearings. This shaft is driven by means of bevel gears. The large bevel gear on the cross shaft is driven by a somewhat smaller gear on the upper extension of the magnet shaft. The ratio of these gears is 4:9—that is—the cross shaft turns at 4/9 the speed of the rotating magnet. Since the magnet is driven at 9/8 e.c.s. speed, the reduction ratio of the bevel gears causes the cross shaft and breaker cam to turn at $(9/8 \times 4/9 = 1/2)$ one-half crankshaft speed.

The bevel gear compartment is packed with special grease. To prevent lubricant leakage from the bevel gear compartment, three Gits type oil seals are used, one just under the small bevel gear, and one in each breaker plate.

To accurately maintain the meshing adjustments of the bevel gears, all bearings in the magneto are preloaded. When the magneto is reassembled after overhaul all bearings must be carefully shimmed to the preload requirements. Also the bevel gears must be accurately set for proper mesh and backlash. Therefore, these adjustments should not be disturbed except when absolutely necessary, at which time it must be done by an experienced mechanic having proper tools.

The coils are sealed in a hard rubber case, to protect them against the effects of moisture and vibration. The primary condensers are sealed in molded cases also.

Besides the condensers for the primary circuits, secondary condensers are also used. These are sealed in molded cases and are connected in series with the secondary circuits.

Two high tension terminals and two ground terminals are provided for each coil. The connections to the distributors can be made from either outlet. For supercharged operation safety gaps are provided, these being fitted into the unused high tension terminal outlets. The primary grounding wires from the ignition switch can be attached to either outlet from their respective coil. The unused outlets are covered by protector caps.

**The term "E" gap is used to denote the number of degrees which the magnet has turned past its neutral position at the time the contact points open.*

SECTION II

ELECTRICAL AND MAGNETIC CIRCUITS

The poles of the rotating magnet are arranged in alternate polarity, so that as the magnet is turned, the direction of the flux through the coil core reverses periodically. The number of flux reversals through each coil core during one complete revolution of the magnet is equal to the number of poles on the magnet.

The flux reversals induce current in the primary winding when the contact points are closed. The flow of current in the primary winding stores energy in the magnetic circuit. When the contact points open, the energy is released, thereby producing high voltage in the secondary winding.

One end of the primary winding is connected to ground. The other end is connected to the insulated contact point of the corresponding breaker assembly, the other contact point of which is grounded. The primary condenser is connected across the contact points.

One end of the secondary winding is grounded to the magneto through the primary winding—that is—connected to the insulated end of the primary. The other end terminates at the high tension insert of the coil. High tension current in the secondary winding is conducted by means of a spring contact button to the secondary condenser and then through an external high tension cable to the central insert of the distributor head, from which it passes to the distributor finger and is then distributed to the electrodes to which the spark plug cables are connected. These cables then carry the current to the spark plugs, where the discharge or spark occurs.

The ground terminal for each coil on the magneto is electrically connected to the insulated contact point of the corresponding breaker. A wire is connected between the ground terminal and the ignition switch. When the switch is in the off position, this wire provides a direct path to ground for the primary current. Therefore the primary current is not interrupted when the contact points open, and this prevents the production of high voltage in the secondary.

SECTION III

INSTALLATION

Before installing a magneto to an engine, always make sure that it has been properly checked and inspected. All adjustments for timing must be made at the drive end of the magneto. *NEVER change the adjustment of the contact points or loosen the contact assembly securing screws when timing to the engine.*

Timing Magneto to Engine

Turn the engine crankshaft until the piston of No. 1 cylinder is in the full advance firing position on the compression stroke in accordance with the engine manufacturer's instructions. This position may be determined with a timing disc or by suitable timing marks on the engine.

Remove the magneto breaker covers and turn magneto drive shaft to the position where a straight edge "K" held against the step of the cam (See Service Chart) lines up with the timing mark "M" on the breaker plate post. At this position the breaker contact points will be just starting to open on the No. 1 lobe of the breaker cam.

NOTE: *If the straight edge does not line up with the mark within 1/64" when the contact points open, do not attempt to correct it by adjusting the contact points. Return the magneto to the bench and recheck the internal timing as instructed in Section VI.*

Install the magneto on the engine in this position, engaging the drive coupling in such a way that the contact points can be opened by turning the complete magneto in the direction OPPOSITE to that indicated by the rotation arrow on the magneto housing. The elongated slots in the mounting flange provide for this adjustment. Set the magneto at the position where the breakers are just on the instant of opening on the No. 1 lobes, at which position a straight edge held against either cam must line up with its corresponding timing mark.

Use the No. 11-851 timing light or equivalent to determine the position where the contacts start to open. The use of shim stock or cellophane strips invariably introduces a possibility of fouling the points, since oil and dirt are nearly always present on such feeler strips. If the strip is of soft material such as cellophane, brass or foil, particles of the strip itself are likely to remain between the contacts, causing unsatisfactory magneto operation. Therefore, avoid the use of feeler strips between the contact points.

A variation in synchronization of 1/2° (measured on the magneto drive shaft) was permitted in setting the breakers at the time the magneto was assembled. This may result in a barely perceptible difference between the opening of the two breakers when checked with the timing light in the above procedure. This small variation will not affect the operation of either the engine or the magneto. If there is a considerable difference between the opening of the two breakers, DO NOT ATTEMPT TO CORRECT IT BY ADJUSTING THE CONTACT POINTS. REMOVE THE MAGNETO and check the internal timing on the bench as covered in the Section entitled "Reassembly", in these instructions.

Always make sure that the straight edge lines up with the timing mark for each cam at the No. 1 firing position because these marks will be used later in maintenance procedures as a reference for adjusting the contact points.

When the magneto has been set at the correct position, tighten the mounting nuts, making sure magneto does not shift when the nuts are tightened.

As a final check turn crankshaft backward about 30° and then forward until the contact points are just starting to open on the No. 1 lobes of the cams. (Use timing light.) The engine should now be at its exact No. 1 firing position and a straight edge, placed on either breaker cam should line up with the mark on the corresponding breaker plate.

Timing Distributor Fingers to the Engine

As these magnetos have compensated cams with the lobes ground at unequal intervals, the position of the high tension electrode on each distributor finger will vary with respect to the distributor head electrode when firing takes place. Therefore, it is important that the high tension electrode of the distributor finger be set in the proper relation to the No. 1 distributor head electrode. This relation is governed by the No. 1 "E" gap engraved on the breaker cam of the magneto. The sparks should jump from the leading half of the finger electrode for the cam lobes having the smaller "E" gaps. (For example, those ranging from 7° to 10°.) For the larger "E" gaps, the high tension electrode of the finger will travel farther past the head electrode when firing takes place. Therefore, in general, the sparks related to the larger "E" gaps (around 17°) will jump from the trailing half of the distributor finger electrode. The important phase then of the distributor finger timing is to make sure that a portion of the finger electrode will always be over the distributor head electrode when firing takes place from any one of the eighteen cam lobes.

For magnetos having a No. 1 "E" gap of 17°, merely position the distributor finger so that the trailing half of its high tension electrode is over the No. 1 distributor head electrode. All other cam lobes having the smaller "E" gaps (down to 7°) will then produce earlier sparks which will jump from the center or leading half of the finger electrode to the head electrode. As a result, some portion of the finger electrode is always over the head electrode when firing occurs. (See Service Chart.)

The method of locating the finger in the required position depends upon the particular installation. For detailed procedure, see the engine manufacturer's instructions.

Wiring

The numbers adjacent to the outlets on the top of the distributor heads indicate the serial firing sequence of the magneto and not the firing order of the cylinders.

Connect the cable outlet marked (1) on the distributor head to No. 1 cylinder, and the cable outlet marked (2) to the second cylinder to fire, etc.

Connect the cable outlet marked "M" on each distributor head to its respective high tension outlet in the magneto. One distributor head will be connected to the outlet on the magneto marked "H.T.-1", and the other will go to "H.T.-2". The outlet (either H.T.-1 or H.T.-2) used for the distributor head on the right or left hand side of the engine will depend on the particular installation. Further, the breaker assembly on the name plate side of the magneto housing operates the coil with the outlet marked "H.T.-2" together with the distributor head connected to this outlet. The other breaker assembly goes with the outlet marked "H.T.-1" and its distributor head. Therefore always determine which breaker assembly operates each distributor head before making final wiring connections.

Connect the ground or switch terminals marked "GR-1" and "GR-2" on the magneto to their respective terminals on the switch. Again, remember that the breaker assembly on the name plate side of the magneto housing is connected to the coil marked "GR-2" and therefore, goes with the distributor head connected to the "H.T.-2" outlet. Obviously, the other breaker assembly goes with "GR-1" and the related distributor head.

Distributor heads for use with high tension booster operation incorporate an outlet marked "B" into which the high tension wire from the booster is connected. Connection for low tension booster operation is made directly into one of the unused ground terminals of the magneto. For detailed instructions see aircraft and engine manufacturers handbooks and Scintilla Service Bulletin No. 95.

SECTION IV

SERVICE INSPECTION AND LINE MAINTENANCE

Lubrication

The ball bearings and gears contain an adequate amount of grease and do not require lubrication between overhaul periods.

Breaker Contacts

a. Inspection of Breaker Contacts

At regular routine inspection periods, remove the breaker covers and check the adjustment of each set of contact points.

IMPORTANT: *The contact points of the pivotless breakers must always be adjusted to open at the proper position of the cam in relation to the timing marks at the breaker end of the magneto and not for any fixed clearance between the contact points.*

To check the adjustment, connect No. 11–851 timing light to both breakers and turn the engine in the direction of its normal rotation to the position where the contact points are just starting to open on the No. 1 lobes of the cams. The No. 1 lobe is marked with a dot. (See Service Chart.)

With the engine at this position a straight edge "K" held against the step of either cam should line up with the mark "M" on the post of the corresponding breaker plate. (See Service Chart.)

A permissible service tolerance of 1/32″ is allowed. That is —the distance between the straight edge and the timing mark must not exceed 1/32″ when the contacts open. It may be found that the both sets of contact points do not open at the same instant, due to unequal wear of the two breaker assemblies. If this is the case, check the alignment of the straight edge with its timing mark on whichever breaker opens first. Then turn engine forward until the other breaker opens and check the alignment of the straight edge with the mark on this breaker.

If it is found that either set of contact points opens more than 1/32″ from its corresponding mark, adjustment of the contact points is necessary.

b. Adjustment of Breaker Contacts

If the above inspection shows that adjustment of the contact points is necessary, turn engine crankshaft backward about 30° and then forward to the position where a straight edge "K" (See Service Chart) placed against the step of either cam, lines up with the timing mark "M" on the post of the corresponding breaker plate. Adjust contact points of both breakers so they are just opening at this position. To make this adjustment, loosen the screws "O" (See Service Chart) and adjust the eccentric screws "P" until the contacts are just beginning to open. Then tighten screws "O" securely and recheck the adjustment.

Use No. 11–851 timing light or equivalent to determine the position where the contacts open. The use of feeler strips for this purpose when adjusting the contact points may cause an error of several degrees to be made in the internal timing of the magneto. Placing of feeler strips between the contacts also increases the possibility of fouling the points with foreign material.

When inspecting the contact points, DO NOT raise the main spring beyond a point giving 1/16 inch clearance between the contact points. Raising it further would weaken the spring.

c. Contact Point Surfaces

If the contact surfaces are fouled with oil or dirt, or are burned excessively, replacement of the complete breaker assembly is recommended. In an emergency, at a location where no replacements are available, a fouled assembly can be made serviceable for temporary use by removing it from the magneto and washing the point surfaces carefully in CLEAN gasoline. If this is done, the gasoline must be allowed to completely evaporate before placing the assembly in service. After the gasoline has thoroughly dried, check the follower felt for the proper amount of oil and lubricate if necessary before installing into the magneto.

d. Lubrication

1. It has been found that a very small quantity of oil will provide lubrication for the cam follower over a considerable length of time, although naturally this varies according to the magneto type and the conditions surrounding it during operation on the engine.

2. Every 400 hours the cam follower should be inspected to see if oil is needed. This inspection should be made by squeezing the cam follower felt tightly between the thumb and forefinger. If the fingers are moistened with oil when this is done, the felt is adequately lubricated and NO MORE OIL SHOULD BE APPLIED. However, if no oil is left on the fingers, the follower felt is too dry and should be oiled as follows:

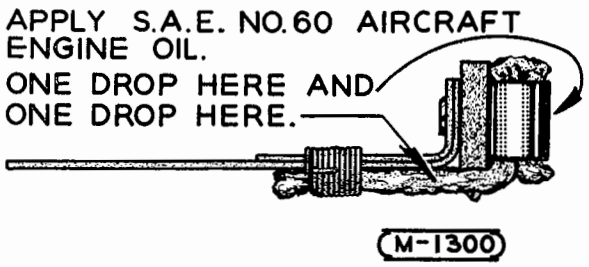


Fig. 1—Line Maintenance Oiling of Cam Follower

3. Apply one drop of S.A.E. No. 60 aircraft engine oil to the bottom felt pad, and one drop to the upper felt pad of the follower assembly as shown in figure 1. Allow at least 15 minutes for the felt to absorb the oil before proceeding further. Do not operate or turn magneto or engine (if magneto is on engine) during the 15 minutes waiting period. At the end of 15 minutes, blot off any excess oil with a clean cloth. The follower is then properly lubricated and ready for use.

4. If the felt strip has the appearance of being saturated with oil, the excess oil should be removed by blotting with a clean cloth.

Always keep the breaker compartments free of oil, and never allow any oil, grease, or engine cleaning solutions to reach the contact point surfaces.

SECTION V

DISASSEMBLY AND INSPECTION

NOTE: *As the magneto is disassembled, always keep all parts together and separate from the parts of another magneto which may be on the bench. All bearings are preloaded and therefore if the same magnet, cam shaft, bearings, shims, breaker plates, etc. are used during reassembly, all adjustments will be considerably simplified. Further, the bevel gears are matched and therefore must always be used or replaced in pairs.*

Gear Cover, Breaker and Coil Covers

Remove the gear cover and clean out the lubricant from the bevel gear compartment. Take off both breaker covers and coil covers. Remove the ground and high tension terminals.

Coils, Primary Condensers and Secondary Condensers

Remove coil securing screws and the screws which secure the primary condenser connectors to the coils. Lift off coils.

Remove the screws which secure the primary connectors to the contact point assemblies.

Remove the four screws which secure each primary condenser, and take out the condensers, spacers, insulating bushings, and primary connectors.

Remove unused high tension terminal caps. Remove the two screws which secure each terminal block, and lift out terminal blocks. The secondary condenser is sealed within the terminal block. Remove the ventilating plates which are secured between the pole shoes under each coil.

Inspect coils, primary condensers, and terminal blocks for cracks in the dielectric or loose connections. Make sure the contact button in each terminal block is not burned and operates feely without sticking. Replace if worn or defective. Test the primary condensers, and secondary condensers electrically as instructed in Section VII, before reinstalling in the magneto.

Breaker Cams and Cross Shaft

IMPORTANT: *When removing the cams and cross shaft, keep in mind that bearings are shimmed for preload requirements and also that these shims are divided properly on each side to give the correct adjustment for the meshing of the bevel gears. Consequently, the breaker plates MUST NOT BE INTERCHANGED. Always reassemble them on the same side of the cross shaft from which they were removed. Also the bearings, spacers, and shim washers must be reinstalled on the same side of the cross shaft to maintain the bearing preload and bevel gear setting. If this practice is followed, reassembly of the magneto will be greatly facilitated. It is suggested that the parts from each side of the cross shaft be placed in separate small paper boxes—properly identified—so that parts will be reinstalled on the same side of the cross shaft from which they were removed.*

Remove the contact assembly from each breaker plate, after taking out its two securing screws. Lift out the eccentric adjusting screws for each contact assembly. Hold magneto drive shaft with No. 11–1487 drive spline wrench and remove the cam securing screws with a 3/8″ socket wrench. Take out the ratchets and pull cams with No. 11–1344 cam puller.

Due to the carbon faced oil seals used in these magnetos, the breaker cam sealing surface is subject to relatively slight wear. It is recommended however, that these cams be lapped to remove the polished ring which is formed on the sealing surface of the cam during operation. This ring actually consists of a series of minute concentric grooves which might cause rapid wear of the carbon ring of the oil seal if the magneto were reassembled without smoothing up the cam. Detailed instructions for lapping the cam are given at the end of this section.

Take out breaker plates. If breaker plates stick, they can be started by inserting two 10–32 screws in the tapped holes in the plate flange and tightening the screws evenly. Mark the breaker plates so they will be used on the same side during reassembly. Remove cork gaskets from the breaker plates. *Do not remove* Gits oil seal from the breaker plates as the whole assembly must be replaced if the oil seal is defective. This is necessary because the bottom surface of the Gits oil seal is machined parallel to the flange face of the breaker plate to prevent cocking of the ball bearing.

Clean up the breaker plate assemblies in kerosene or gasoline and blow out with compressed air. DO NOT USE ACETONE OR THINNER to clean the breaker plates, because these liquids will attack the impregnating varnish used in the sealing diaphragm. Inspect the oil seals visually to see that the springs under the seal ring have not slipped out of their sockets, and to make sure the seal ring has easy action when compressed with the fingers.

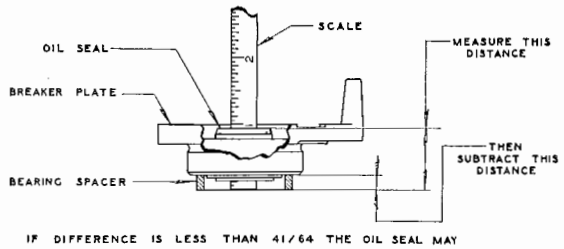
Try the oil seal with the fingers to test for internal leakage. This can be done by compressing the oil seal with the fingers, at the same time stopping off the ends of the seal with the thumbs. Compression of the air within the seal can be felt if the seal is satisfactory. If no compression can be felt, the seal is leaking internally and the complete breaker plate assembly must be replaced.

Lift out the spacer and shims from each side of the cross shaft and place them in separate boxes properly identified for reassembly purposes. Remove the lock nut on the cross shaft which holds the ball bearing up against the large bevel gear. To do this, hold the cross shaft with the No. 11–1735 wrench which fits the splines of the shaft, and then take off lock nut using a 7/8″ socket wrench.

Be careful not to damage the gear teeth. Hold large gear away from pinion and turn it until the flat on the shaft is toward the pinion, providing the necessary clearance to slide the shaft out. Then still holding large gear away from pinion, remove shaft by exerting pressure with the hand on the No. 1 breaker side of the magneto. The shaft is then taken out from the nameplate side. (If shaft sticks, it may be tapped LIGHTLY with a rawhide mallet to start it, PROVIDED that the gears are held apart, otherwise the gear teeth may be chipped when the mallet is used). The bearing on the nameplate side will come out with the shaft. Push out the other bearing by hand or with No. 11–1471 pressing tool.

Place box wrench No. 11–1487 over splines on drive shaft and remove pinion gear securing screw with a 3/8″ socket wrench. Remove pinion gear with No. 11–1482 pinion gear remover set and take out the shims directly under it. Watch for shims which may stick to the bottom of the pinion. Do not interchange gears with those from another magneto. The bevel gears are matched in pairs which must be run together. Each pair of gears has a serial number which is engraved on each gear. The gears must be installed or replaced in pairs having the same serial number. Keep the shim washers together so they can be used for reassembly.

Inspect bevel gears. If worn excessively or if teeth are nicked or damaged, replace both gears which are supplied in pairs only.


SCALE
OIL SEAL
BREAKER PLATE
BEARING SPACER
MEASURE THIS DISTANCE
THEN SUBTRACT THIS DISTANCE
IF DIFFERENCE IS LESS THAN 41/64 THE OIL SEAL MAY NOT CONTACT CAM PROPERLY WHEN MAGNETO IS ASSEMBLED.

METHOD OF MEASURING OIL SEAL M-997

Fig. 2

Do not remove the bearing which is pressed onto the cross shaft unless it is defective. However, if necessary to remove this bearing, place the shaft and bearing on No. 11-1343 support yoke and press out shaft with an arbor press, using a fiber pad between the arbor and the shaft end. The flats of the shoulder on the shaft must fit in the slot in the yoke.

Clean and inspect the ball bearings. If worn or defective, replace. If bearings are satisfactory, lubricate with ANDOK "C" grease before reassembly.

Inspect the oil seals in the breaker plates. If either seal shows evidence of leaking or if the sealing surface is scored, cracked, or worn excessively, a complete new breaker plate and oil seal assembly must be installed.

Due to the position of the oil seal in the breaker plate, it is not practical to try smoothing it up by lapping. If the carbon seal ring is not worn too badly it will give satisfactory service provided the breaker cam is smoothed by lapping as instructed at the end of this section. To provide a satisfactory seal, the carbon ring must be compressed at least .020″ against its spring when the breaker cam is secured in position. If it is desired to check this before reassembly, the oil seal can be measured as shown in Fig. 2. If oil seal measures less than the minimum dimension shown, it is worn to the extent that it may not properly contact the breaker cam after assembly.

Check the tension of the main springs of the breaker contact assemblies with gauge No. 11–2731. When making this check, be sure that the hook of the gauge is applied under the main spring adjacent to the contact point (E) as shown in Fig. 3. If the tension of a main spring that has been used is 15 oz. or more, it is satisfactory for further service. If it is necessary to install a new main spring, its tension should be from 20 to 32 oz. The No. 10–3768 shims (See Fig. 3) are used primarily to line up the contact points squarely to obtain maximum contact surface between the points. The number of 10–3768 shims used also affects the main spring tension. Main spring tension is decreased by the addition of 10–3768 shims and increased by removal of shims.

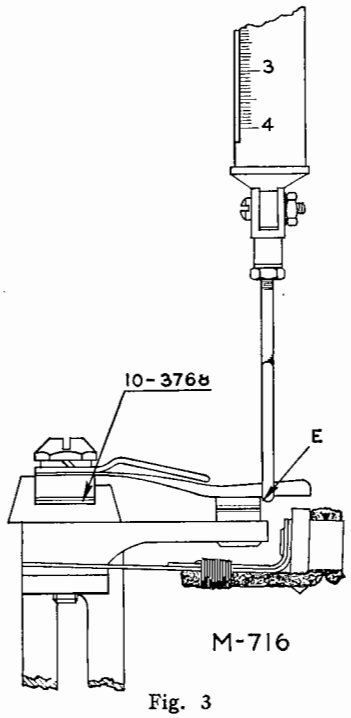


Fig. 3

Front End Plate, Rotating Magnet, and Magneto Housing

Take out screws holding front end plate to magneto housing. Remove front end plate by tapping it lightly with a rawhide mallet.

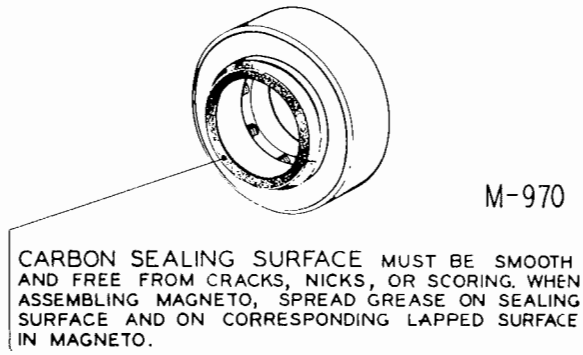
Cut off locking wire on retainer screws and then remove screws and retainer. Lift out the shim washers and ball bearing. Keep shim washers together for reassembly. If ball bearing sticks and cannot be lifted out by hand, place drift No. 11–1514 on the outer race, having the front end plate in sleeve No. 11–1287. Using an arbor press, push out bearing and oil seal. Inspect drive shaft oil seal. If it is worn or shows evidence of leaking, replace.

Pull out rotating magnet from housing. Remove the upper ball bearing and spacer by hand. Also take out the lapped washer of the upper oil seal. If the bearing sticks, the lapped washer and bearing can be pushed out with a piece of 5/8″ wooden dowel rod inserted through the oil seal from the gear compartment. The spacer can then be removed.

Examine the lapped washer for wear on the surface which runs against the oil seal. This surface cannot be used against the oil seal again because the oil seal would not run in the same "track" on the washer. If the washer is not worn too badly it can be reversed, provided of course that the other side is unused. This must not be done if the washer is worn deeply or irregularly, because the worn side might not seat flat against the bearing, and this would cause the washer to run out of true or warp sufficiently to allow leakage.

Do not remove the oil seal from the housing unless the oil seal is defective. This oil seal is reamed to maintain the necessary close limits of concentricity with the magnet bearing bores and to provide the required close fit with the shank of the pinion gear. An oil seal which has been removed *CAN NOT be reinstalled*, but must be replaced by a new one which must be *reamed and checked after installation* as instructed in the Section entitled "Reassembly".

Inspect the oil seal in the housing for evidences of leaking and to make sure the sealing surface is not scored, cracked, or worn excessively. (See Fig. 4.) Check oil seal for internal leakage by testing the compression as instructed above for the breaker plate oil seals. Use a short rubber cork in the seal inside the housing if the seal cannot be reached with the thumb. If oil seal is not satisfactory, press out with No 11–1471 pressing tool.


M-970
CARBON SEALING SURFACE MUST BE SMOOTH AND FREE FROM CRACKS, NICKS, OR SCORING. WHEN ASSEMBLING MAGNETO, SPREAD GREASE ON SEALING SURFACE AND ON CORRESPONDING LAPPED SURFACE IN MAGNETO.

GITS OIL SEAL

Fig. 4

Clean and inspect the ball bearings. If bearings are rough, noisy or otherwise unsatisfactory, replace. If bearings are satisfactory repack with ANDOK "C" grease before reinstalling.

Inspect all parts of magneto housing. See that all threaded holes are clean and that threads are in good condition. Blow ventilator and drain holes with an air line.

Distributor Assembly

Inspect all dielectric parts of the distributor head and fingers for cracks. Examine the cable holes and remove any foreign particles which may be in them. The No. 11–1413 tap is used for cleaning the tapped holes for the cable piercing screws and high tension electrodes of the distributor heads.

If heads incorporate spring type carbon brushes, make sure that brush operates freely and is not cracked or worn excessively.

Examine the replaceable high tension electrode on the finger. If electrode is worn down to the line engraved on its surface, the electrode must be replaced.

Examine the distributor head electrodes. If electrodes are worn excessively, replace or change position of the electrodes so that worn side is turned away from the finger. When installing electrodes, tighten to a torque value of 18 to 22 inch pounds with the No. 11–1753 tension screwdriver.

Clean the dielectric surfaces of the distributor heads and fingers with acetone*, using a stiff brush or clean cloth. This will remove any condensation or conducting films which may have formed on the surfaces during operation.

After cleaning, dry thoroughly. If an oven is available, bake for about 3 hours at a temperature of 140° to 150° F.* Then apply a thin coat of Scintilla No. 72 Compound and place in an oven at 160° to 170° F. for 1½ hours.

Procedure for Relapping Breaker Cams

For a lapping plate use a piece of plate glass about a foot square. Place a few drops of kerosene oil in center of plate and rub a small amount of 9M16 Lapping Compound (purchased from Hanson-VanWinkle-Munning, East Matawan, N. J.) into the kerosene, spreading a thin film of kerosene and compound over the plate. Do not use an excessive amount of either kerosene or compound. In general the thinner the film, the flatter the surface of the cam will be when the job is finished.

Rub the base of the cam in the compound on the plate using a circular motion and turning the cam on its own axis every two or three strokes. Keep an even, moderate pressure on the cam while lapping.

After lapping for a few minutes, clean up cam and observe the surface. If there are any deep grooves, it may be necessary to use a coarser abrasive to remove them. If so, clean up the plate and cam and place a very small quantity of FFF emery powder on the plate, with several drops of kerosene. Lap as before being very careful to apply even pressure on both sides of cam. Keep turning the cam to equalize the cutting. Only a very few strokes should be needed with the emery powder. When grooves are no longer visible, wash plate and cam thoroughly to remove all traces of emery. (Usually it will not be necessary to use emery. Do not use it unless it appears that considerable time will be required with 9M16.)

Finish the cam to a high polish, using No. 9M16 Lapping Compound. As the cam begins to take a polish, remove compound from the plate, so that the final strokes are made with very little compound on the plate.

Clean surface by rubbing on a piece of paper laid over the lapping plate. The cam base should be mirror-like with no scratches. If necessary, continue lapping with 9M16 compound to obtain required finish.

When required finish is obtained, wash cam thoroughly and place a thin film of No. 30 oil on lapped surface.

CAUTION: *If necessary to use emery powder, extreme precautions should be taken. Arrange the lapping bench away from the magneto overhaul bench. Wash all parts of cam thoroughly before transferring cam back to overhaul bench. Do not wash cams in the same tank used for washing magneto parts. This is necessary to prevent any chance of emery or lapping compound getting on the parts of the magneto.*

*CAUTION: *ACETONE is inflammable and should therefore be used in a well ventilated area where no open flame is present. If an oven is used, it should be of the electric type and ventilated to allow escape of fumes. As a safety precaution, the acetone should be allowed to air dry as much as possible before putting the parts in the oven.*

SECTION VI

REASSEMBLY

Magneto Housing, Rotating Magnet, and Front End Plate

If the oil seal has been removed from the magneto housing, a new one must be installed. Apply a light coating of No. 47 Compound to the oil seal before pressing into position. To install the oil seal use No. 11–1472 pressing tool and an arbor press. The seal ring (Fig. 4) of the oil seal faces toward the rotating magnet. Make sure the plain end of No. 11–1472 tool is used for the oil seal. The end having the long extension is used to install the bearing and must not be used for the oil seal. After installing oil seal look into gear compartment and make sure the oil seal is fully seated against the shoulder at the upper end of the bushing in the housing. Carefully remove all excess compound and any chips or shav ings which may have been scraped off the oil seal during the pressing operation.

The hole in the upper face of the oil seal must be reamed to the correct diameter and concentricity after installing. To accomplish this use No. 11–1691 reaming fixture, which pilots on the rotating magnet bearing seats in the housing. Do not undertake to ream the seal with an ordinary expansion reamer. Instructions for the use of No. 11–1691 reaming fixture are supplied with the tool. After reaming, the hole diameter in the oil seal must be checked to make sure it is within the limits of "GO" and "NO GO" plug gauge No. 11–1693. Finally, inspect carbon sealing surface of oil seal, to make sure it has not been damaged during the reaming and gauging operations.

Place the large diameter spacer in position adjacent to the oil seal in the housing. Place small amount of No. 30 oil around the oil seal under the spacer.

The bearing for the upper end of the magnet must have a light push fit. Before installing try the bearing on the magnet to make sure it is not too tight. (See Fig. 5.) If fit is satisfactory repack bearing with ANDOK "C" grease before installing it in the housing.

The bearing and lapped washer can be installed in one operation by using the No. 11–1472 pressing tool. The extension on one end of this tool provides a means of keeping the hole in the washer in alignment with the hole in the bearing. Place the bearing on the extension of the tool, having the sealed side of the bearing against the flange of the tool.

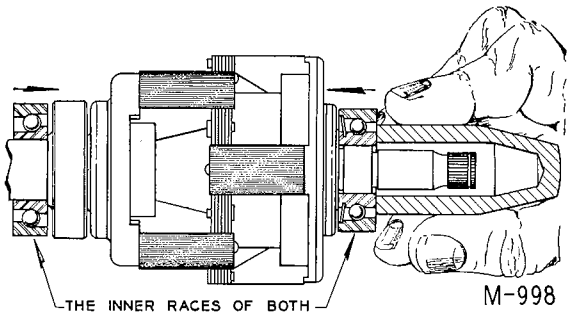

M-998
THE INNER RACES OF BOTH OF THESE BEARINGS MUST HAVE A LIGHT PUSH FIT ON TO BEARING SEATS OF SHAFT. ALWAYS MAKE SURE BEARING SEATS ARE SMOOTH AND CLEAN. DO NOT USE AN ARBOR PRESS.

Fig. 5

Spread a light coating of grease on both sides of lapped washer and place washer against the bearing on the extension of No. 11–1472 tool. Then insert bearing and lapped washer into recess in magneto housing. DO NOT use an arbor press for this operation. The bearing should be a light push fit in the housing.

NOTE: *Inspect lapped washer before installing. If either side is worn or scored excessively, use a new washer. If one side has been used, but is not scored or worn deeply, the washer can be reversed by placing the unused side against the oil seal. Do not use either side of the washer more than once.*

After installing the bearing and lapped washer check to make sure lapped washer compresses oil seal at least .020″ when bearing is fully seated. To do this, reach into the housing with the fingers and push the bearing up against the oil seal. When this is done it should be possible to feel the oil seal compress slightly. When pressure is released the oil seal springs must push the bearing back to its former position. If they do not, either the bearing is too tight or the oil seal is worn or defective. If bearing is too tight use another bearing which has a light push fit in the housing. If oil seal does not compress slightly with the new bearing, the seal is defective and must be replaced, since it is required

that the oil seal be compressed at least .020" when the bearing is fully seated in the housing.

Place a thin film of Andok "C" Grease or equivalent on laminations of magnet and on pole shoe surfaces inside of magneto housing. Recharge the magnet using No. 11-1362 charger and No. 11-1488 adaptors. Make sure there are no chips or foreign particles on rotating magnet. Make sure lapped washer is centered between bearing and Gits oil seal and insert rotating magnet into housing by hand. Do not use an arbor press for this operation.

Check the fit of the bearing in the front end plate to make sure it has a light push fit. If bearing is too tight use another bearing or dress out the inner diameter of the ball bearing bushing slightly with emery cloth. Be sure no emery gets in the bearing or remains in plate. Remove bearing from front end plate after final check.

Press the rawhide oil seal with open side down into front end plate using drift No. 11-1514 in conjunction with an arbor press. New seals must be soaked in S.A.E. No. 40 Motor oil for 12 hours before installing, to soften the leather.

Fill oil seal with ANDOK "C" grease. The grease is packed in back of the leather sealing surface. Also fill the space between the oil seal and the ball bearing with grease. Place bearing on magnet shaft to check the fit. It must have a light push fit when applying hand pressure on drift No. 11-1473 (See Fig. 5). If fit is satisfactory, pull off bearing by hand as it cannot be installed until the front end plate is assembled to the housing.

Place front end plate over drive shaft of magnet and in position on the magneto housing. Secure with its six screws, lipped plain washers and lockwashers. Tighten screws to a torque value of 25 to 30 foot pounds as measured with the No. 11-1682 torque wrench.

Lubricate bearing with ANDOK "C" grease and place it in position on bearing seat of rotating magnet shaft. The wall of the outer race is not as wide on one side of the bearing as it is on the other. The wide wall of the bearing must face the drive end of the magneto. Bearing must be installed by hand or by applying hand pressure with drift No. 11-1473 which fits on the inner race. Do not use an arbor press.

Determine the amount of shimming required to provide 60 ± 15 pounds preload for the rotating magnet bearings. To determine the shims use No. 11-1685 preloading tool set* in accordance with the following instructions.

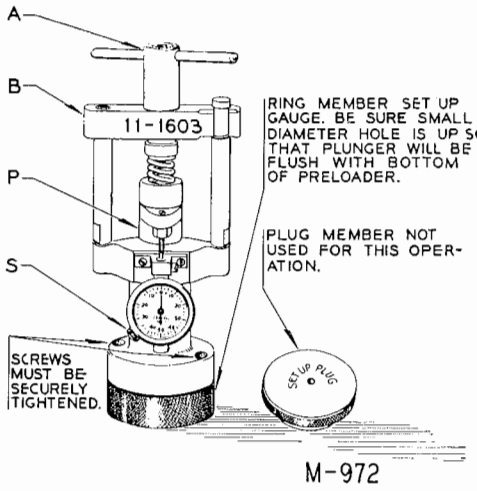
Procedure for Preloading Rotating Magnet Shaft Bearings

Check to make sure the dial indicator of No. 11-1603 Preloader reads zero when bottom surface of plunger "P" is exactly flush with gauging surface on bottom of machine. (See Fig. 6.) To do this, loosen handle "A" and swing bar "B" over to one side. Then secure preloader to set-up gauge. Make sure the side of set-up gauge having small diameter hole is against bottom of preloader. The side having the large diameter hole must not be used for this operation as the bottom of plunger would enter the hole. Engage bar "B' and screw down handle "A". This will push plunger "P" down against set-up gauge in which position it will be exactly flush with gauging surface on bottom of machine. The dial should read zero at this position. If it does not, loosen locking screw "S" on indicator dial and set the zero mark exactly under indicator hand, after which lock dial in position by tightening screw "S". After setting preloader, loosen handle "A", to relieve spring tension. Then remove the set up gauge from preloader.

Place magneto in the inverted position, having the drive shaft up. Place No. 11-1603 preloader in the recess of front end plate, and secure by engaging the two screws of preloader in two of the holes for the drive shaft bearing retainer screws in front end plate. (See Fig. 7.)

*The No. 11-1685 Preloading Tool Set consists of the following parts:

1 11-1603 Preloader for Rotating Magnet Shaft Bearings.
1 11-1604 Preloader for Cross Shaft Bearings.
1 11-1626 Gauge Set consisting of ring and plug members, for use in setting preloaders to the correct zero dimension before use.

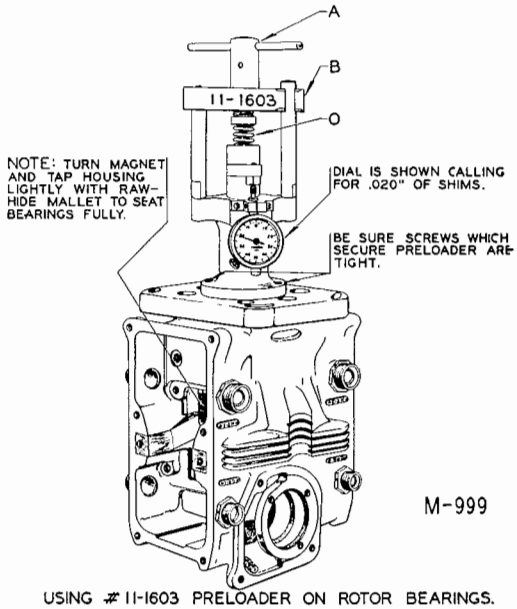

A
B
11-1603
P
S
RING MEMBER SET UP GAUGE. BE SURE SMALL DIAMETER HOLE IS UP SO THAT PLUNGER WILL BE FLUSH WITH BOTTOM OF PRELOADER.
PLUG MEMBER NOT USED FOR THIS OPERATION.
SCREWS MUST BE SECURELY TIGHTENED.
SET UP PLUG
M-972

CORRECT SETTING OF DIAL OF #11-1603 PRELOADER

Fig. 6

NOTE: *Always make sure that the recess where preloader fits in front end plate is free from chips or dirt and that there are no burrs or nicks on the surface where preloader seats.*

Swing bar "B" to the operating position and then tighten down handle "A" as far as possible. The spring "O" (Fig. 7) provides the correct load for the bearings when handle is tightened as far as it will go. At this position the indicator reads directly the amount of shims required to have the bearings assembled with the correct preload. This amount of shims is indicated by the anti-clockwise reading (marked "–" on the dial) of indicator.


A
B
11-1603
O
NOTE: TURN MAGNET AND TAP HOUSING LIGHTLY WITH RAWHIDE MALLET TO SEAT BEARINGS FULLY.
DIAL IS SHOWN CALLING FOR .020" OF SHIMS.
BE SURE SCREWS WHICH SECURE PRELOADER ARE TIGHT.
M-999

USING #11-1603 PRELOADER ON ROTOR BEARINGS.

Fig. 7

CAUTION: *To get an accurate reading it is necessary that the bearings and shaft be fully pressed down into their normal positions. Sometimes the bearings do not seat fully due to the drag of the drive shaft oil seal or the spring tension of the Gits oil seal or to a slightly snug fit of the bearings themselves. It is recommended that the magnet be turned several revolutions after tightening preloader handle "A", and that the magneto housing be tapped lightly with a rawhide mallet while doing this, so that the*

magnet and all parts will be fully seated before taking the reading on the indicator. The indicator readings are MEANINGLESS unless the bearings and all parts are fully seated.

Loosen handle "A" and remove preloader from magneto. Install shims equal to the reading of indicator. Measure each shim separately with a micrometer and add thickness to obtain total called for by preloader. Do not measure shims in a stack. Shims are available in thicknesses of .0025", .004", .005", .008", .010", and .012".

Check shims after installation by securing preloader directly over shims in magneto. Tighten handle "A", rotating the shaft and tapping as before, at which time indicator hand should read zero.

If indicator reads clockwise (marked "+" on dial) too many shims are being used, probably due to an error in measuring the shims. If indicator reads anti-clockwise (marked"–" on dial) there are not enough shims. Increase or decrease amount of shims as indicated by dial until exact zero reading is obtained. Then install retainer and secure with 6 screws and safety wire.

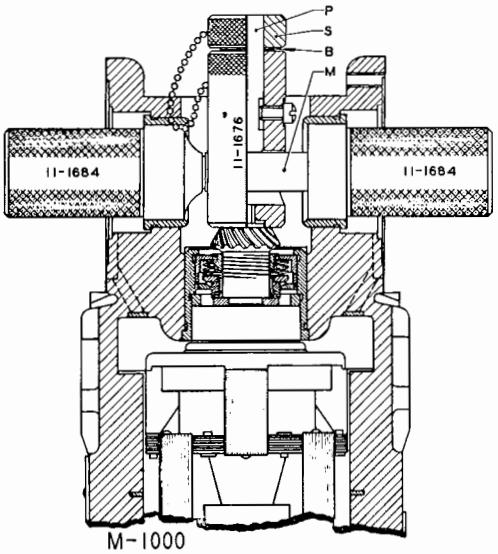
IMPORTANT: *Always inspect retainer carefully before installing. If retainer is bent or deformed, or shows any signs of wear, it should be discarded and a new retainer used.*

Procedure for Setting the Pinion Gear

The pinion gear must be shimmed to the correct height to provide proper meshing with the large gear. The machined surface at the top of the pinion must be $1.0085^{+.0020}_{-.0000}$ below the top of the cross shaft when magneto is assembled. (See dimension on Service Chart.) To determine the quantity of shims required, use No. 11–1676 gauge and No. 11–1684 gauging mandrel in accordance with the following instructions. Observe the serial numbers on the gears as they are matched and must be kept in original pairs.

Turn magneto upright, having gear compartment at top. Place the pinion gear in position, however, do not install the shims at this time. Attach No. 11–1676 gauge in position over pinion. (See Fig. 8.) The threaded stud of the gauge fits the tapped hole in the magnet shaft extension. Screw the gauge down as tightly as possible with the fingers, but do not use any tool to tighten it.

Line up the hole in the gauge with the cross shaft bearing bores and insert No. 11–1684 gauging mandrel "M" (See Fig. 8) which fits the cross shaft bearing seats as shown, and is designed so that it corresponds exactly to the position of the cross shaft in the magneto.



M-1000
USING PINION HEIGHT GAUGE.

Fig. 8

Having the gauge and mandrel installed, observe the distance plunger "P" (See Fig. 8) extends out above sleeve "S". The gauge is designed in such a way that when the pinion is at the correct height, the plunger "P" and the sleeve "S" will be exactly smooth across their top surfaces. Therefore, with no shims installed, the plunger of the gauge will extend up from the face of the sleeve a distance equal to the amount of shims required.

Take off sleeve "S" and install shims under it as shown at "B" (Fig. 8) until top of plunger is just level with top of sleeve, when sleeve is held firmly down on shims. The relative positions of the plunger and sleeve can be readily felt when the finger is drawn across the top of the gauge. When no difference in height can be felt between the plunger and the sleeve, the shims at "B" represent the approximate amount to be installed under the pinion gear.

Be sure sleeve is pressed firmly down on shims. The shims are available in thicknesses of .0025", .004", .008", .010", and .012".

Remove the gauging mandrel and take out pinion gear. Install the shims under pinion gear.

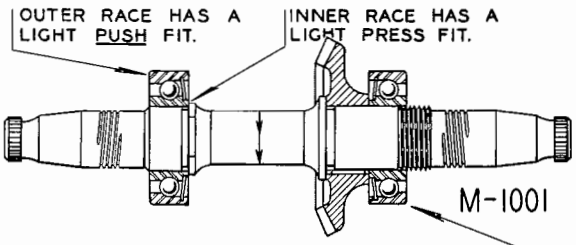
Install gauge and mandrel again to obtain the accurate setting. Tighten gauge down on pinion as tightly as possible with the fingers, to compress the shims under the pinion. If pinion is correctly shimmed, the plunger "P" and the sleeve "S" will be perfectly smooth across their top surfaces when felt with the finger. It may be found that the plunger extends up very slightly from the sleeve when making this check. This is because the shims were compressed slightly when the gauge was screwed down. In this case try adding .001" of shims, which will usually correct the alignment. The shims are correct when the plunger and sleeve are smooth across the top.

The original shims removed from the magneto will no doubt equal the amount indicated by No. 11–1676 gauge. If not, however, use shims as indicated by the gauge to insure correct setting of the pinion.

Having the correct amount of shims under pinion, tighten pinion securely with its washer, lock and screw. When tightening pinion, hold drive shaft with box wrench No. 11–1487. *Always remove shavings or chips which may come off from lockwasher when tightening the screw.*

The inner race of the bearing opposite the gear on the cross shaft, as shown in Fig. 9 is the only bearing having a press fit. If this bearing was removed, press it onto its seat using No. 11–1471 pressing tool. Place the bearing on the pressing tool in arbor press, having the sealed side of bearing up. Press shaft down into bearing. Pad the end of the shaft to prevent injury by the arbor. Make sure shaft enters straight into bearing.

After installing this bearing check the fit of the other cross shaft bearing to make sure it is a light push fit. (See Fig. 9.) This bearing must go on its seat by hand.



DO NOT USE AN ARBOR PRESS TO INSTALL THIS BEARING. BOTH INNER AND OUTER RACES HAVE A LIGHT PUSH FIT.

Fig. 9

See that bearings are properly lubricated with ANDOK "C" grease. However remove all grease and dust from the outer faces of the bearings and the bearing seats in the housing so that cross shaft and bearings will slide easily back and forth in the housing. (See Fig. 10.)

Insert cross shaft, at the same time engaging bevel gear with its Woodruff key. The flat on the shoulder of the cross shaft for the bevel gear must face down while inserting the cross shaft, to provide installation clearance over the pinion. Install bearing adjacent to bevel gear and secure inner race up

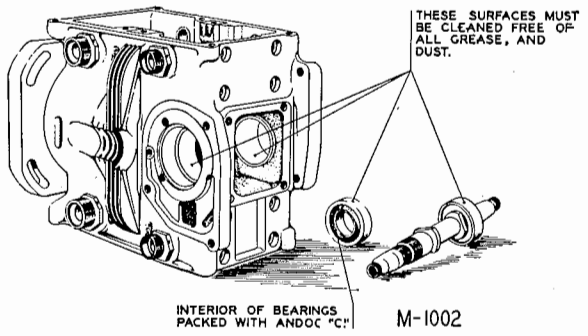


Fig. 10

against bevel gear with the ear lockwasher and ock nut. To tighten lock nut, hold cross shaft with No. 11–1735 wrench and use a 7/8″ socket wrench. The chamfer on the lock nut must face towards the ear lock. Bend up ears of washer against sides of lock nut. Make sure both bearings are lubricated with ANDOK "C" grease. The cross shaft can now be pushed back and forth by hand, so that the bevel gear can be moved up to or away from the pinion.

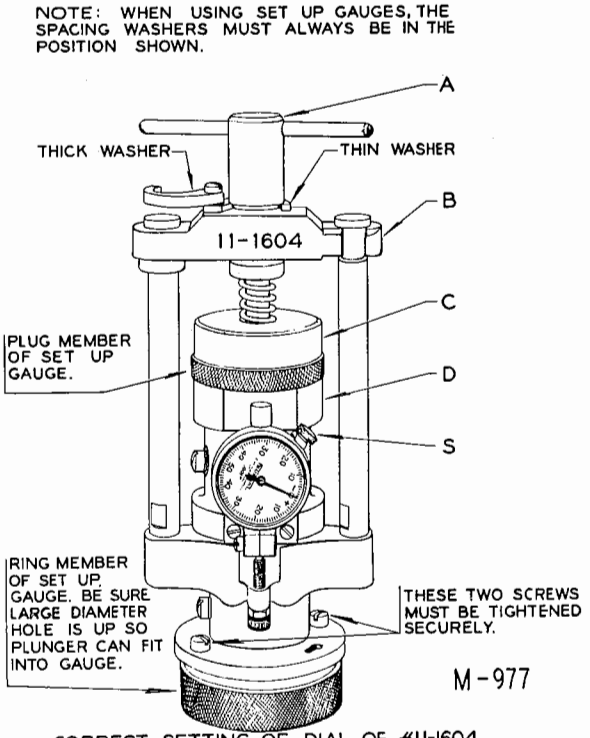
Engage bevel gear with pinion.

Procedure for Setting Large Bevel Gear

The setting of the large bevel gear with relation to the pinion gear is determined by the amount of shims on the gear side of the cross shaft. Just enough shims must be used on the gear side to provide the proper backlash of the gears. To determine the amount of shims, the No. 11–1604 preloader is used.

When using No. 11–1604 preloader, the spacing washers at the top of the machine must always be in the position shown in Fig. 11. That is—the thinner washer must be under the handle, and the thicker washer must be swung out of the way since it is not to be used for the magnetos covered by this instruction.

Check No. 11–1604 preloader before using, to make sure the dial indicator is correctly set. To do this loosen handle "A" and swing bar "B" to one side. Install ring member of set-up gauge to base of preloader and secure with two screws. Then place plug member of gauge in recess in sleeve "D" swing bar "B" over in position and clamp down by tightening handle "A" as far as it will go. (See Fig. 11.)


NOTE: WHEN USING SET UP GAUGES, THE SPACING WASHERS MUST ALWAYS BE IN THE POSITION SHOWN.
A
THICK WASHER
THIN WASHER
B
11-1604
C
PLUG MEMBER OF SET UP GAUGE.
D
S
RING MEMBER OF SET UP GAUGE. BE SURE LARGE DIAMETER HOLE IS UP SO PLUNGER CAN FIT INTO GAUGE.
THESE TWO SCREWS MUST BE TIGHTENED SECURELY.
M-977

CORRECT SETTING OF DIAL OF #11-1604 PRELOADER.

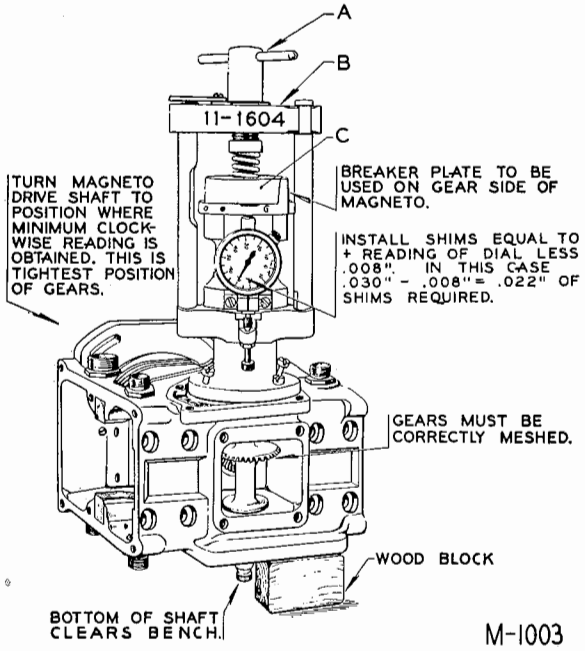
Fig. 11

CAUTION: *When using the set-up gauges, always make sure that all gauging surfaces are clean.*

When handle "A" is tight, the hand of the indicator should be at zero position. If it is not, recheck to make sure there are no dirt particles on the gauging surfaces. If all surfaces are clean, set gauges up as before. Then loosen locking screw "S" on the indicator and set zero mark of dial exactly under indicator hand after which lock dial in position by tightening screw "S". When indicator has been set correctly, loosen handle and remove the set-up gauges from preloader.

Place magneto with the gear end of cam shaft up. Provide a wooden block to support magneto so it will not rest on the lower end of cam shaft. (See Fig. 12.) The weight of magneto may cause an inaccurate reading if the magneto is allowed to rest on the shaft end. Be sure gears are meshed correctly.

Place thick spacer in position against bearing on gear side of magneto, having spacer absolutely clean. Attach No. 11–1604 preloader on the gear side of magneto using the two screws provided. Loosen handle "A" and swing bar "B" over to one side. Place breaker plate which is to be used on this end of shaft in the recess in top of sleeve "D" in preloader. The breaker plate used in this measurement should be stamped or marked "G" to show that it goes on the gear side of the magneto so that the two breaker plates will not be inadvertently exchanged later. After putting breaker plate in recess, swing bar "B" over in position and tighten handle "A" down as far as it will go.

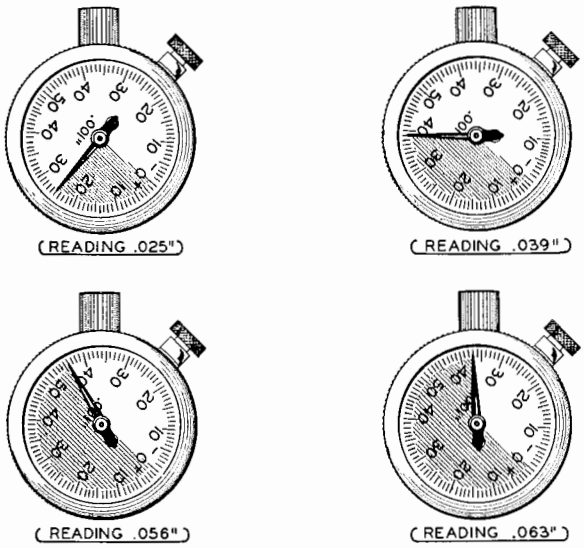

A
B
11-1604
C
TURN MAGNETO DRIVE SHAFT TO POSITION WHERE MINIMUM CLOCK-WISE READING IS OBTAINED. THIS IS TIGHTEST POSITION OF GEARS.
BREAKER PLATE TO BE USED ON GEAR SIDE OF MAGNETO.
INSTALL SHIMS EQUAL TO + READING OF DIAL LESS .008". IN THIS CASE .030" - .008" = .022" OF SHIMS REQUIRED.
GEARS MUST BE CORRECTLY MESHED.
WOOD BLOCK
BOTTOM OF SHAFT CLEARS BENCH.
M-1003

DETERMINING SHIMS REQUIRED ON GEAR SIDE.

Fig. 12

Turn magneto drive shaft through nine complete revolutions and observe the minimum and maximum readings of the indicator. Tap on the pressure plate "C" LIGHTLY with a screwdriver handle (do not use a hammer) while turning, to seat all parts down completely.

Place rotor where the minimum "+" (clockwise) reading of the indicator is obtained, which is the position where the gears are tightest. Take this minimum reading and subtract .005″ from it, and then measure up shims with a micrometer to equal this remainder. Measure each shim separately and add thicknesses to obtain total. Do not measure shims in a stack.



SAMPLE DIAL READINGS OF # 11-1604 PRELOADER. M-979

Fig. 13

NOTE: *If more than .050" of shims is needed on this side of magneto, the indicator hand will come to rest on the "–" side of the dial. Should this be the case take care to read the dial correctly. The amount of shims is indicated by the CLOCKWISE position of the hand from zero as shown in the sample readings in Fig. 13.*

It is always desirable to use as few and as thick shims as possible. For example if .038" of shims are needed, use three .010" shims and one .008" shim rather than six .005" and two .004" shims. The reason for this is that a large group of thin shims—especially shims which have been used before—may behave somewhat like a spring. This not only hampers the operator in obtaining accurate readings with the preloader but also gives a less rigid support to the gears after the magneto is assembled. NEVER USE SHIMS WHICH ARE BENT OR DENTED.

Loosen handle "A" and swing bar "B" over to one side. Take out breaker plate and put shims under it. Then replace breaker plate and tighten down handle "A". Tap on pressure plate "C" as before to seat all parts down completely. The indicator should now read + .005". If it reads more than .005" *add* the necessary shims to reduce reading to .005". If it reads *less* than .005" *take out* shims to increase reading to .005".

The .005" dimension used in the above procedure, is an allowance for the backlash of the gears. If the .005" allowance were not subtracted, the gears would be meshed under slight pressure, and obviously would be too tight, resulting in destruction of the gears when run. Experience indicates that the allowance of .005" is approximately correct for most magnetos. However, the total thickness and conditions of the shims used will affect this allowance. For this reason it may be found that subtracting .005" gives too much backlash in some cases. If the mechanic finds, as a result of his experience, that the allowance of .005" is continually giving too much backlash in the assembled magnetos, the allowance may be reduced. However it is not recommended to reduce it to less than .004".

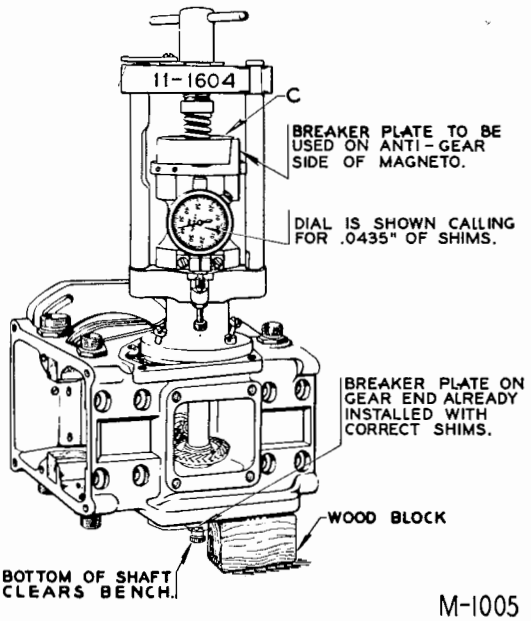
When the correct amount of shims has been determined, turn the shaft to the position where the gears are loosest (maximum "+" reading of indicator). With gears in this position remove preloader and install shims in recess in magneto.

Install cork gasket on breaker plate to be used on gear side. Apply No. 47 compound sparingly around the pilot just sufficiently to prevent lubricant leakage. Make sure no compound gets on flange surface as this might prevent breaker plate seating properly.

Install breaker plate to magneto, and run screws just down against their lockwashers but DO NOT TIGHTEN. Then secure No. 11-1604 preloader to the anti-gear side of magneto, after having placed the thin spacer in position against the bearing on this side. Place breaker plate to be used on this side of magneto in position in the top of the sleeve of preloader. (See Fig. 14.) Place a wood block under magneto so it will not rest on shaft end. Note clockwise reading of the indicator at this position. Measure up shims equal to the reading and put this amount of shims in recess under breaker plate and tighten down handle again.

Now turn magneto on its side and tighten the other breaker plate securing screws up evenly, at the same time trying the gear backlash with the fingers to make sure the backlash does not disappear when the screws are tightened. If backlash disappears while tightening the screws DO NOT TIGHTEN FURTHER. Loosen the screws and recheck the procedure, as there are too many shims under the breaker plate on the gear side of the magneto, and to tighten the screws further would cramp the gears and damage the teeth.

When screws are tight, again place magneto in the position shown in Fig. 14. Turn magneto shaft through several revolutions and tap lightly on pressure plate of preloader, to make sure all parts are fully seated. Then observe reading of indicator. If indicator hand is on "+" clockwise side of zero, add shims as indicated, to make it read zero. If hand is on the "–" anti-clockwise side of zero, take out shims. Always make sure the bearings are fully seated when taking a reading on the indicator. This is done by turning shaft and tapping pressure plate of preloader lightly. Shim preloader to the exact zero position.


11-1604
C
BREAKER PLATE TO BE USED ON ANTI-GEAR SIDE OF MAGNETO.
DIAL IS SHOWN CALLING FOR .0435" OF SHIMS.
BREAKER PLATE ON GEAR END ALREADY INSTALLED WITH CORRECT SHIMS.
WOOD BLOCK
BOTTOM OF SHAFT CLEARS BENCH.
M-1005

DETERMINING BALANCE OF SHIMS REQUIRED ON ANTI-GEAR SIDE.

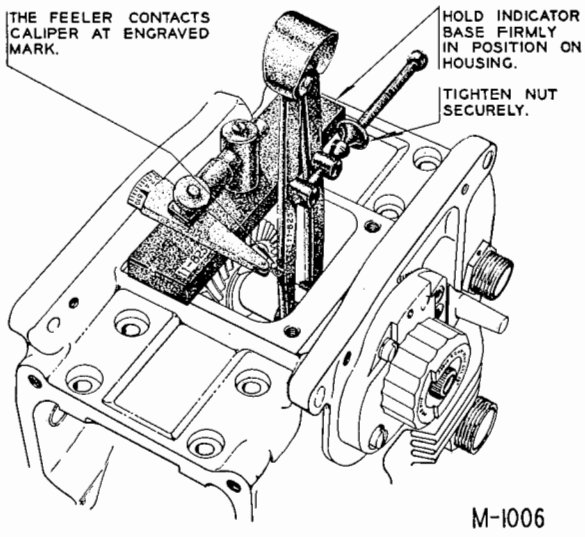
Fig. 14

When the correct amount of shims has been determined so that the indicator of preloader reads zero, take out breaker plate and shims and remove preloader from magneto. Place the shims in position against the spacer. Place cork gasket on breaker plate using No. 47 compound if necessary (as instructed for the other breaker plate) and secure breaker plate in position with its three screws and lockwashers.

Check the backlash of the gears using the No. 11-825 indicator. To do this secure either cam in position and attach No. 11-740 timing tool to cam. Secure the caliper member of No. 11-825 tool to the cross shaft in the gear compartment on the side opposite the large gear. Place the indicator assembly on the flat surface of the gear cover seat and adjust feeler of indicator so that it contacts the caliper at the engraved line on one side of the legs. (See Fig. 15.) By means of the No. 11-740 timing tool rock the cross shaft back and forth through the range permitted by the backlash of the gears, and measure the amount of movement of the

caliper member of No. 11–825 tool. The indicator assembly must be placed in position so that the pointer will not go off the scale at either end.

CAUTION: *It is not recommended to lock the rotating magnet with the timing disc during the backlash check, because of the possibility of altering the position of the magnet and pinion gear when the lock on the timing disc is tightened. Experience will show that the backlash can be accurately checked without locking the magnet.*


THE FEELER CONTACTS CALIPER AT ENGRAVED MARK.
HOLD INDICATOR BASE FIRMLY IN POSITION ON HOUSING.
TIGHTEN NUT SECURELY.
M-1006

USING # 11-825 BACKLASH INDICATOR.

Fig. 15

Hold indicator assembly firmly down on housing with the hand, so that the base of the indicator cannot move relative to the magneto. Also make sure that the rotating magnet does not turn when rocking the cross shaft. Check the backlash at 90° intervals of rotation of the magnet shaft through four complete revolutions of the large gear.

The backlash as read on the indicator must not be less than .0015″ at the tightest position, nor more than .0075″ at the loosest position of the gears.* If the backlash is not within these limits it will be necessary to change some of the shims of the cross shaft bearings.

For example if the gears do not have sufficient backlash they are too tight, and therefore the bevel gear must be moved away from the pinion by taking some of the shims from the gear side and moving them over to the other side. Approximately .001″ of shims will correct .0015″ of backlash as indicated by the No. 11–825 indicator.

If gears are too loose, the necessary amount of shims will have to be taken away from the bearing opposite the gear and placed in position on the bearing adjacent to gear. This will move the cam shaft and bevel gear up the pinion.

If it is found necessary to change shims from one side to the other *be sure that the total thickness of shims* at both ends of the shaft is not altered, as this would destroy the preload adjustment of the bearings.

Place 2-1/3 ounces by weight of Texaco Regal Starfak No. 2 grease in the gear compartment. (Should Texaco Regal Starfak No. 2 not be available, the only acceptable substitute is Texaco Regal Starfak "Special".) This will bring the surface of the lubricant level with the TOP of the cross shaft. If facilities are not available for weighing the grease, fill to level of TOP of cross shaft but MAKE SURE GREASE IS PACKED TIGHT all around the gears to eliminate all air spaces or pockets.

Cover lapped surfaces of cams and oil seals with a light coating of No. 30 oil.

*The indicator reads 1½ times the actual backlash as measured on the outer diameter of the teeth of the large gear. Actual backlash must not be less than .001″ nor more than .005″.

Place breaker cams in position on their respective ends of the cross shaft. Check each cam to make sure it compresses the corresponding oil seal at least .020″ when seated on its taper. If it does not, check for dirt on tapered surfaces. If the cam does not compress the oil seal at least .020″ the indications are that the oil seal is worn down too far to provide the proper contact. In this case a new breaker plate and oil seal assembly must be used. If this is done, the bevel gear and cross shaft preload must be readjusted.

Remember that the breaker cams are not interchangeable as they are right and left hand cams. Check the position of the cams by turning magneto shaft in direction of operating rotation and observe to see that cams turn in the direction of the arrows engraved on them. Place timing ratchets and washers in position and fasten cam securing screws. Do not seat cams too firmly on their shafts or tighten securing screws at this time as the cams must be moved when timing the magneto.

Turn the rotating magnet slowly and examine each pole piece carefully. Remove any chips or foreign particles which may have adhered to them. Check clearance between each pole piece on the rotating magnet and its corresponding pole shoe. The clearance must not be less than .0015″ at any position. (See Service Chart.) Secure ventilating plates between pole shoes.

Place the lockwasher, plain washer, and cork washer over each one of the four securing screws for each primary condenser, and then insert screws into the holes provided in the magneto housing. Place the two insulating bushings on the screws nearest the center of the magneto and the two plain bushings on the two outer screws. Place primary connector in the correct position over the two insulating bushings, and then secure each primary condenser in position.

Treatment of Contact Points at Time of Magneto Overhaul

a. General Information

Disassembly and dressing of the contact points should NOT be made a regular routine step of the magneto overhaul procedure. This statement is made because information obtained from the field indicates that many operators are actually overdoing the matter of contact point service, by performing expensive and unnecessary overhauls on the point assemblies. As a result, many sets of points reach the scrap bin prematurely, with perhaps 2/3 to 3/4 of the contact material filed away by repeated dressing operations. On the other hand, some operators report 12,000 to 14,000 hours of service per assembly, as a result of an efficient inspection set up under which disassembly and dressing of the contacts is performed only when absolutely necessary to remove deep pits or mounds or to smooth severely burned contacts. In a majority of cases, the contacts will be found satisfactory when removed from the magneto at overhaul time, and in this instance a simple cleaning, inspection, and lubrication routine is all that need be performed.

b. Cleaning

1. Wash the entire assembly in clear CLEAN gasoline to remove all oil. Use a small brush to work around the points and to scrub the felt of the cam follower lightly in order that any particles of dirt or grit will be removed. (See figure 16.)

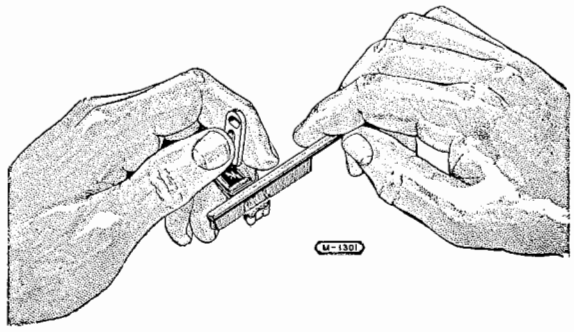


Fig. 16—Scrubbing Follower with Brush

2. Blow the assembly dry with a compressed air jet which should be directed over all parts of the assembly, particularly the follower felt and the point surfaces, which latter should be held apart so that the air can evaporate all traces of the solvent and remove any dirt which may have lodged between them.

3. If the above cleaning has been properly done, the felt strip on the cam follower should come out nearly white when dry. If the follower does not appear thoroughly clean, repeat the washing, working the solvent thoroughly into the felt with the fingers. Be sure the solvent is all removed from the felt by blowing with compressed air.

c. Inspection

1. Breaker Cam Follower

a. After cleaning the cam follower felt, inspect it to see that it is in good condition and securely fastened to the follower spring. Make sure none of the threads which bind the tail of the felt strip are broken. Use a new follower, if the felt is loose or torn or if there are any broken threads.

b. Check the fiber block of the follower for excessive wear at the point where it lifts against the mainspring. After long periods of operation there will be a certain amount of normal wear at this point, causing a small depression to be worn in the top of the fiber block. If the bottom of this depression is less than 1/32-inch from the top of the spring to which the fiber is riveted, the fiber is worn beyond safe limits and should be replaced. (See figure 17.)

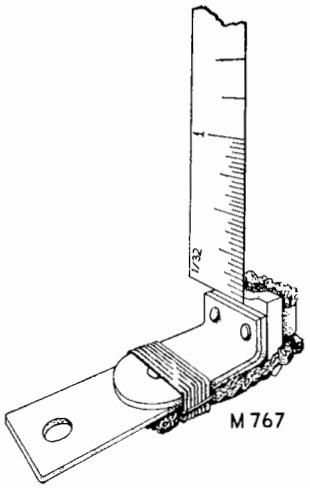


Fig. 17—Inspect Cam Follower Block

c. Check the bottom of the follower block for excessive wear or a "battered" condition. The surface which rides the cam should be smooth and hard. If there is any evidence of splitting or cracking of the fiber, the follower should be replaced.

d. Check the follower for loose rivets which secure the fiber block to the springs. This may be done by applying a light twisting force to the block while holding the spring. If there is any looseness or movement of the block or the rivets with respect to the spring the follower should be replaced.

2. Point Surfaces

a. Figure 18 shows how the average contact point will look when the surfaces are separated for inspection after the assembly has been removed from the magneto. The contact surfaces have a dull gray, sandblasted appearance (almost rough) over the area where electrical contact is made. This gray frosted surface means that the points are worn in and mated to each other thereby providing the best possible electrical contact, and the highest efficiency of performance. Points in this condition should not be disassembled, nor should the assembly securing screw be loosened or tampered with, since this would change the relation of the points and destroy the perfectly mated fit of their surfaces.

b. Minor irregularity or roughness of the point surfaces is not harmful. Neither are small pits or mounds, if not too pronounced. It is sometimes difficult to judge whether a point is pitted deeply enough to require dressing, because in the final analysis this depends on how much of the original platinum pad is left on the point surface. The danger arises

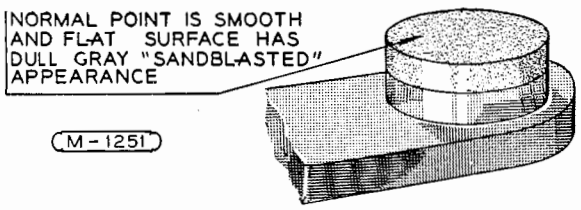


Fig. 18—Normal Contact Point

from the possibility of the pit becoming deep enough to penetrate through the platinum pad, which may be thin due to long service or previous dressing operations.

c. To assist mechanics in judging the thickness of the platinum pad, the No. 11–1871 gage has been provided. The point is checked by applying the gage in the manner shown in figure 19. A point is satisfactory if its contact surface is level with or extends above the surface of the gage. If any part of the point surface is below the gage surface, the platinum is too thin for safe use and a new point assembly should be installed. Points which pass the gage check are considered satisfactory for operation through one overhaul. However the gage cannot reveal precisely the extent to which pits may have decreased the pad thickness.

d. In the absence of qualified experience in this matter, it is safest to redress the points if there are any well-defined mounds on either surface. Figure 20a and 20b will help the reader to understand the difference between "minor irregularities" and "well-defined mounds" as covered in the above discussion. An outline of the dressing operation is covered under heading *general outline of contact point dressing technique.*

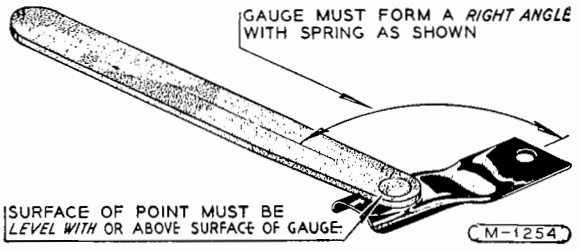
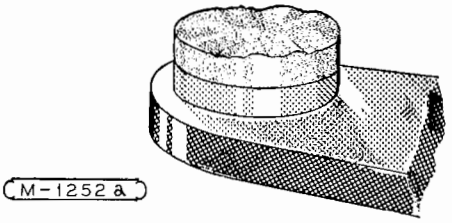
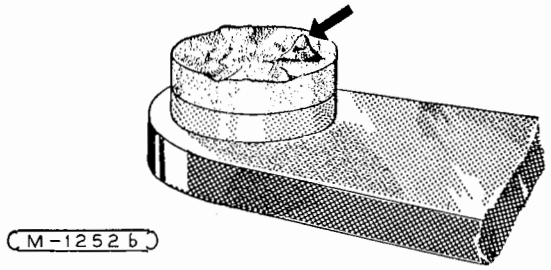


Fig. 19—Application of No. 11-1871 Gage



MINOR IRREGULARITIES — SMOOTH ROLLING HILLS AND DALES WITHOUT ANY DEEP PITS OR HIGH PEAKS. THIS IS A NORMAL CONDITION OF POINT WEAR.

Fig. 20a—Point with Minor Irregularities



WELL DEFINED MOUND EXTENDING NOTICEABLY ABOVE SURROUNDING SURFACE. THE MATING POINT HAS A PIT OR HOLE CORRESPONDING TO THE MOUND SEEN HERE. *THESE POINTS NEED DRESSING.*

Fig. 20b—Point with Well-Defined Mounds

3. Mainspring Tension

Check the tension of the mainspring of the contact assembly in accordance with the instructions in Section V. If the tension is low, disassembly of the points will be necessary in order to correct it. If disassembled, the points must be redressed, because it will be impossible to reassemble them in their original relation. See below, for an outline of the dressing operation.

4. Lubrication

After thoroughly cleaning and inspecting the assembly it should be relubricated by applying three drops of S.A.E. No. 60 oil to the bottom felt of the cam follower and two drops of the same oil to the upper part of the felt. (See figure 21.) The assembly should then be allowed to remain undisturbed for at least 15 minutes before operating it in a magneto. This interval of time will allow the oil to penetrate the felt and minimize any tendency for the oil to be thrown off during operation.

5. General Outline of Contact Point Dressing Technique

a. For dressing the contact points after disassembly the No. 11–1248 contact point dressing kit is used. Instructions provided with this kit cover the general method of use, however, the following information supersedes and supplements certain information given in the instructions supplied with the kit.

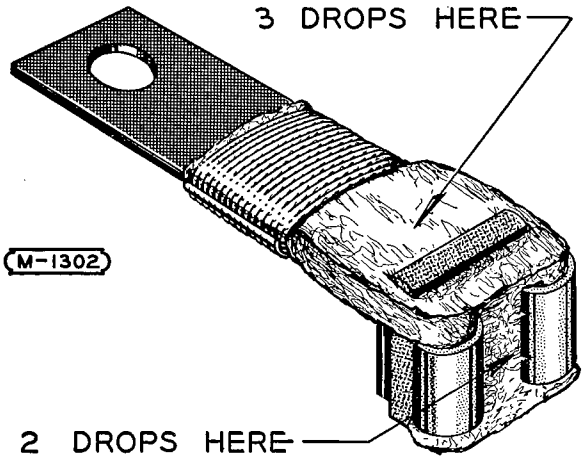


Fig. 21—Overhaul Lubrication of Cam Follower

b. When dressing a set of points which have been rejected due to pits and mounds, do not try to completely remove the pit. File the point only enough to smooth and flatten out all the surface around the pit. This will usually leave plenty of contact area around the hole as shown in figure 22 and the assembly will perform in the same manner as a perfect point. It is obvious that if the pit were deep, most of the platinum pad might be removed if an attempt were made to entirely eliminate the pit by filing.

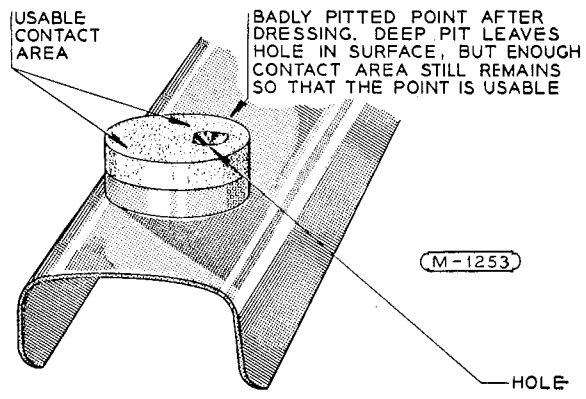

USABLE CONTACT AREA
BADLY PITTED POINT AFTER DRESSING. DEEP PIT LEAVES HOLE IN SURFACE, BUT ENOUGH CONTACT AREA STILL REMAINS SO THAT THE POINT IS USABLE
M-1253
HOLE

Fig. 22—Pitted Point After Dressing

c. When dressing the mounded point, the mound must be entirely filed off. The surface of this point should be perfectly smooth and flat to provide the largest possible contact area against the other point which now will have a slightly decreased area due to the remaining pit.

d. It is not necessary to obtain a mirror finish on the contact surfaces when completing the dressing operation. Only a few strokes of the stone are required to remove any ridges or burrs left by the file. The most important factor is to have the points flat so that they will provide satisfactory contact area when assembled.

e. After dressing the points, check the thickness of the point itself with the No. 11–1871 gage as outlined under heading 2, *c*. This will show whether there is still enough platinum on the point to last until the next overhaul.

f. If the points were disassembled in order to correct low spring tension, it is recommended that the correction be made by installing a new mainspring. By the exercise of proper care and judgment many operators are making this correction by bending the spring slightly. If this is done, it is advisable to bend the spring with the fingers, in order to avoid concentrated stresses which might weaken the spring if it were bent sharply with pliers. Usually it only requires a very slight bending to correct the tension so that it is within required limits.

> CAUTION: *Should it be found that the spring was bent too much, as evidenced by excessive tension when checked after assembly, do not attempt to correct the tension further by bending the spring a second time. Discard the spring and use a new one.*

g. Use the No. 11–1275 assembly tool when assembling the component parts of the breaker. In doing this the operator should strive to obtain full contact area between the point surfaces. In a practical sense however, full contact area is often difficult to obtain since it requires both perfect squareness and perfect flatness of the points. A workable standard is about 2/3 of full contact area, provided the contact is on the side away from the cam follower block. Contact area can be checked by holding the assembled breaker toward the light and observing whether the light can be seen between the point surfaces as shown in figure 23. At final assembly, the securing screw which holds the breaker parts together should be tightened to a torque value of 18–20 inch-pounds.

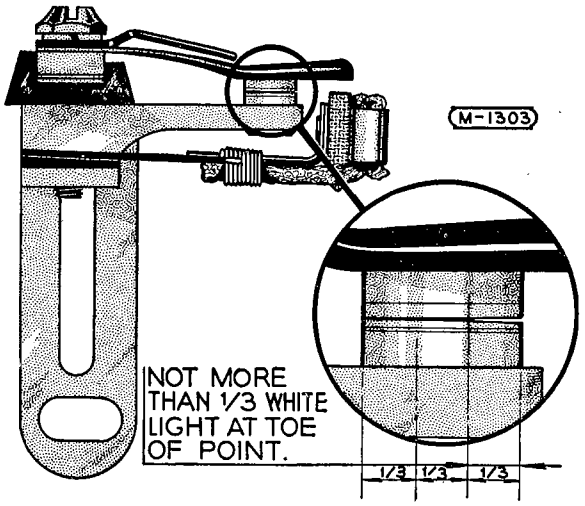


Fig. 23—Checking Point Contact Area

Secure contact point assemblies in position on each breaker plate and then fasten each primary connector with its securing screw, lockwasher, and plain washer.

Internal Timing

The procedure for timing the cam and setting the contact points depends upon whether or not the original breaker plate is to be used.

If the original breaker plate is used, the timing mark which is engraved on it can be used as a reference for setting the cam on that side of the magneto as instructed under heading *a.* below.

However, if a new breaker plate (not having a timing mark) is to be used, it will be necessary to follow instructions under heading *b.* below, in order to correctly locate and inscribe the timing mark on the new breaker plate.

a. Instructions for Timing Cam and Adjusting Contact Points when using Original Breaker Plate Inscribed with a Timing Mark.

Place timing disc No. 11–1474 on rotor shaft and place a timing disc pointer in position. Adjust pointer so that it comes over the degree markings on the timing disc. The rotating magnet must turn freely to find the neutral position, and, therefore, do not lock rotor with the locking attachment on the timing disc.

Place rotating magnet in any one of its eight neutral positions. A pole piece will be midway between the pole shoes when the rotating magnet is in its neutral position. Also the rotating magnet will have a tendency to come to a definite stop or remain at rest at each neutral position as it is turned slowly by hand Therefore a neutral position can be easily located by feel as the rotating magnet is turned slowly.

Having the rotating magnet in neutral, adjust the timing disc pointer so that it comes over any one of the degree markings on the timing disc.

Turn rotating magnet in direction of operating rotation the exact number of degrees specified for the No. 1 "E" gap for the particular cam used. The No. 1 "E" gap is stamped on the face of the cam. (Also the No. 1 "E" gaps for these magnetos are shown in Table 1 under "DESIRED E GAP ON No. 1 LOBE").

Earlier execution cams on the DF18 magneto should be replaced with the polished cams. The No. 10–24963 and No. 10–24964 cams which are polished may be identified by the letter "K" engraved on the step of the cam. Cam 10–21701Y, which is polished, has the letter "P" engraved on the step and polished cam 10–21702Y has the letter "Q" engraved on the step.

Lock rotating magnet firmly in its No. 1 "E" gap position using the locking device on the timing disc.

Remove either cam securing screw and lockwasher. Loosen cam so that it can be turned on its taper. If cam is tight, use puller No. 11–1344 to loosen it. Place spring No. 11–1520 over cam screw and then place the plain washer up against the spring. Make sure timing ratchets are in position and partially screw in cam screw with the No. 11–1520 spring and plain washer.

When installing the ratchets note that the teeth on one side of the intermediate (ring) ratchet will not mesh with the teeth in the cam recess, therefore make sure this ratchet is installed right side up. Also check to make sure the ratchets operate freely. Ratchets which stick or bind will seriously interfere with the work of timing the magneto and therefore should be corrected or replaced.

Place the No. 11–740 timing tool in position on cam so that the straight edge is flush up against its step. Tighten cam screw just enough to push cam fully on its taper. In doing this, it will be necessary to overcome the spring tension of the Gits oil seal ring which has a tendency to push the cam off its taper. When the cam is pushed on its taper by tightening the cam screw, ratchet the cam back and forth with the No. 11–740 timing tool. Then when the cam is fully seated, the No. 11–1520 spring under the cam screw will still give the ratchet effect required.

Place a cam screw having its lock-washer and plain washer on it on the work bench so that it will be readily available for installation when the No. 11–1520 spring is removed.

Ratchet cam until the straight edge coincides perfectly with the timing mark on the breaker plate post. The ratchets provide a vernier adjustment. Turning the cam one click (or tooth) in the clockwise direction moves it 15 degrees. Then turning it one click in the anti-clockwise direction moves it back 15.65 degrees, leaving a resultant change of .65 of a degree in the anti-clockwise direction. Make sure the ratchets are fully meshed at the instant the straight edge coincides with the timing mark. If this is not done, the ratchets may loosen while magneto is in operation, with resultant damage.

When the cam is positioned by means of the ratchets so that the straight edge perfectly coincides with the timing mark, push firmly against the No. 11–740 timing tool with the hand so that the tension of the seal ring of the Gits oil seal will not force the cam off its taper. While holding the cam firmly in with one hand, remove the securing screw along with the No. 11–1520 spring and plain washer and install the cam securing screw, lock-washer, and plain washer which was previously placed beside the magneto. Tighten cam screw securely.

Before loosening the lock on timing disc, set other cam by means of the ratchets, using the same procedure as was used for the first cam. Then loosen locking device on timing disc and recheck setting of both cams.

To do this, turn rotating magnet back to its neutral position and adjust timing pointer so that it comes over any degree marking on timing disc. Then turn rotating magnet to the position where the straight edge on one of the cams, lines up with its corresponding timing mark and observe the number of degrees disc was turned from neutral. This number of degrees must equal the number of degrees specified for the No. 1 "E" gap, or be within the tolerance specified in Col. (1) of Table 1. Then place straight edge on other cam to make sure it also lines up with its corresponding timing mark at the No. 1 "E" gap position of the magnet. If necessary, readjust cam by means of the ratchets, as each cam must line up with its corresponding mark at the same position within the tolerance given in Col. (1) of Table 1, at which time the magnet must be at its "E" gap position.

Adjust the contact points. To do this place the magnet in its exact No. 1 "E" gap position where the cams line up with their respective marks. Lock magnet in this position. Connect No. 11–851 timing light or equivalent across contacts of both breakers and adjust contact points so they are just starting to open at this position. Then unlock magnet and recheck setting to make sure contact points open at the position where the straight edge coincides with the timing mark. (See Service Chart.) The two contact assemblies must open at the same instant within 1/2 degree as measured with the No. 11–1474 timing disc and No. 11–851 timing light.

b. Instructions for Timing Cam, Adjusting Contact Points and Inscribing Timing Mark When Using A New Breaker Plate Not Engraved with Timing Mark.

First, set the contact points so that they remain open on No. 1 lobe the number of degrees specified in Column (2) of Table 1.

To do this, use timing disc No. 11–1474, timing light No. 11–851, and a timing disc pointer. The cam must be secured firmly in any position on its tapered shaft. Turn the rotating magnet until contact points just begin to open on the No. 1 lobe. Record the timing disc reading at the instant contact points begin to open. Turn the rotating magnet just enough to allow the cam follower to pass over the No. 1 lobe to a position where the contact points just close again. Record the timing disc reading at the instant the contact points close. The difference between the two timing disc readings gives the number of degrees that the contact points remain open on No. 1 lobe. If the difference does not equal the value specified in the table for the cam, reset the contact points. To do this, loosen the two securing screws for the contact point assembly and turn the eccentric to the right to decrease the contact point opening or to the left to increase it. After the correct setting is obtained, tighten the two securing screws for the contact point assembly. Always recheck the setting after the securing screws for the contact point assembly are tightened to make sure contacts remain open the number of degrees specified in the table.

Turn and lock the rotating magnet in its No. 1 "E" gap position which is engraved on the cam, or shown in Table 1.

Loosen cam and place the No. 11–1520 spring under the cam securing screw. Place timing tool No. 11–740 in position on the cam. Ratchet the cam until the ratchets are in full engagement at the position where the No. 1 lobe of the cam is just opening the contact points (as the cam is turned in direction indicated by arrow engraved on it). *Do not change the setting of the contact points as this would alter the number of degrees for which they were set to remain open on No. 1 lobe.* When the cam is ratcheted to the correct position, hold timing tool No. 11–740 firmly by hand and take out the No. 11–1520 spring after which secure cam firmly with its screw, lockwasher, and plain washer. Recheck setting. To do

this, unlock rotating magnet and turn it back to its No. 1 neutral position. Record timing disc reading. Then turn rotating magnet until the contact points just begin to open on the No. 1 lobe and note the "E" gap indicated in degrees on the timing disc. If the No. 1 "E" gap is not correct, the cam was not set accurately. In this case, reset cam to correct error.

Using a straight edge, place a timing mark on the breaker plate post with a pencil in line with the step on the cam at the instant the contact points begin to open on the No. 1 lobe.

Experience will show that a suitable combination of "E" gaps and point openings in degrees, can usually be obtained so that all are within prescribed tolerances. If a suitable combination cannot be found, indications are that the cam or the cam shaft taper are not concentric, in which case new parts should be tried.

Check the synchronization of the breaker assemblies. They should open at the same instant within 1/2° measured on the magnet shaft with the timing disc No. 11–1474. The contact point setting on either or both sides can be changed slightly to obtain synchronization. In doing so, however, do not exceed the tolerances on "E" gaps, or point opening, both of which must be checked again if the contact point setting has been changed to obtain synchronization.

After the cam is properly set with all phases of the internal timing within prescribed tolerances, the timing mark can be inscribed on the breaker plate post. To do this, turn the rotating magnet until the contact points just begin to open on the No. 1 lobe. Then using a straight edge, inscribe the timing mark on the breaker post in line with the step of the cam.

Completion of Assembly

Install terminal blocks to magneto and secure with two screws and lockwashers. Place coils in position, making sure contact button on terminal block engages coil properly. Start coil grounding lug screws first, then insert and tighten coil core screws, using new ear lockwashers. Then tighten grounding lug screws. Secure primary condenser connectors to coils with their screws, plain washers and lockwashers.

Examine the cam follower felts to make sure they are properly lubricated. If oil appears on the surface when the felt is squeezed with the fingers, no oil is needed. If felt is dry, apply a few drops of Aircraft engine oil, S.A.E. No. 60, or equivalent grade under Army and Navy Specifications.

Examine the wire braid gasket in the coil and breaker covers. If the gaskets are deformed or torn, replace as outlined below.

Pull the gasket through the fingers several times to smooth out any small bends and remove any irregularities. This will cause the metallic braid cover to conform smoothly to the contour of the round neoprene core. Determine the exact length of gasket required by laying it carefully over the contour of the sealing groove holding it in place temporarily by means of paper tape if necessary. Cut the gasket to the proper length plus 1/8 inch surplus for trimming, taking care to maintain the round shape of the gasket as much as possible.

Cut one end of the gasket at a 45° angle and start laying the gasket in the groove. The gasket must be inserted without stretching.

The loose end of the gasket should also be cut at a 45° angle to closely match the end of the braid in the groove, so as to make a neat joint where they meet.

The gasket must be well seated in the groove by light blows of a fiber or phenolic hammer having an unmutilated face, or it may be formed into position in the groove by means of a flat block of wood. The surface of the gasket when formed into position should be about .015" above the face of the covers. It is considered satisfactory if the gasket is firmly seated in the groove so that the covers may be handled and the part will not loosen at the joint or fall out of its own weight.

To further improve the shielding and sealing function of the gasket and to assure its proper seating in the groove, it is recommended that the gasket be smoothed out by sliding a smooth object such as the face of a hammer over it in a circular direction while applying pressure.

If any gaps show between the ends, the gasket must be replaced with one giving a perfect joint, because any air leaks due to an imperfect joint will cause trouble in supercharging the magneto.

Place coil covers with gaskets in position and fasten them with their securing screws and lockwashers.

Install ground and high tension terminals in their respective outlets.

After completing the final test of the magneto, install the breaker covers with their gaskets. Cover the four securing screws of each primary condenser with a suitable sealing wax to prevent entrance of dirt or moisture. Install the tapered bushing over splined drive shaft and screw on the drive shaft nut and plain washer.

TABLE 1—SHOWING DATA FOR CORRECT SETTING AND TIMING OF BREAKER CAMS

Part No. of Cam	Engraving on Front of Cam				1	2	Magneto Type
	Engine	Master Rod Locations	Direction of Cam Rotation	Desired "E" Gap on No. 1 Lobe	Tolerance for No. 1 "E" Gap	Points Remain Open on No. 1 Lobe	
10–21701Y	R-2800	MR 8–13	→	17°	±1°	18°±1°	DF18RN, DF18LN
10–21702Y	R-2800	MR 8–13	←	17°	±1°	18°±1°	DF18RN, DF18LN
10–24963	R-2800	MR 8–9	→	11°	±1°	23°±1°	DF18RN, DF18LN
10–24964	R-2800	MR 8–9	←	11°	±1°	23°±1°	DF18RN, DF18LN

1. All angular measurements are made on magneto drive shaft.
2. The No. 1 lobe of cam is marked with a dot.

SECTION VII

MAGNETO TEST PROCEDURE

Test Equipment

In order to closely simulate actual operating conditions, it is important to test the magneto in conjunction with two distributors. The following test stand is recommended for this purpose.

GREER HYDRAULICS 18-CYLINDER LO-HI TENSION IGNITION TEST STAND, MODEL MG-1, made by Greer Hydraulics, 454 Eighteenth Street, Brooklyn 15, N. Y. Details may be obtained from the manufacturers at the above address.

Emergency Test Set-Up

If it is necessary to obtain an approximate check of one of these magnetos, at a location where neither of the above stands are available, Bendix-Scintilla No. 11–700 test stand can be used for a short test run.

Since there are no distributors in the circuit when testing by this method, the actual operating conditions are not duplicated. Moreover, since all sparks occur at one gap for each coil, it is difficult to observe high speed missing. However if care and judgment are exercised, a fairly accurate practical test of the magneto may be obtained by this method.

Place the magneto on the test stand with nameplate down, using a wood spacer 2″ × 1-1/2″ × 5/16″ under the magneto nameplate to keep magneto level. Secure the magneto with the clamping device on the test stand. Fasten No. 11–1303 special pulley to the magneto drive shaft with the standard drive shaft nut. Connect one high tension outlet from each coil to one of the 7 m/m gaps, on the spark panel. Provide a ground wire between the magneto housing and the metallic mass of the test stand, otherwise the paint coating of the magneto may prevent a proper return ground from the spark gap. Do not operate magneto for extended periods when using this emergency arrangement or the test stand motor may become overheated.

General Mechanical Test

Operate magneto at various speeds for several minutes to check mechanical operation. Hold contact points open and note sound of gears and bearings. Shut off power and listen for any unusual noises as magneto speed declines. Observe contact points for excessive arcing. However, slight arcing of points after overhaul is not objectionable.

Test Run

When the operator has made sure there are no obvious faults in the assembly of the magneto, it should be operated for about 5 minutes at 2000 R.P.M.

Coming In Speed

Check the coming in speed, which is the lowest speed at which the rotating magnet must be turned to produce consistent sparking at all the gaps. The magneto should spark consistently at 120 R.P.M. If magneto does not spark consistently at 120 R.P.M. check for loose connections in the high tension wiring to the test gaps and check the gaps themselves to make sure electrodes are properly pointed and correctly adjusted.

The correct gap for all tests except where otherwise specified, is a seven millimeter, three point gap, the electrodes of which are sharpened to a 45° included angle with not greater than an .008″ radius at the apex of the cone thus formed. The teaser electrode is mounted at right angles to the main electrodes and spaced .007″ from the nearest surface of the live electrode. The axis of the teaser is located 1 m/m below the point of the live electrode. (See Fig. 24.)

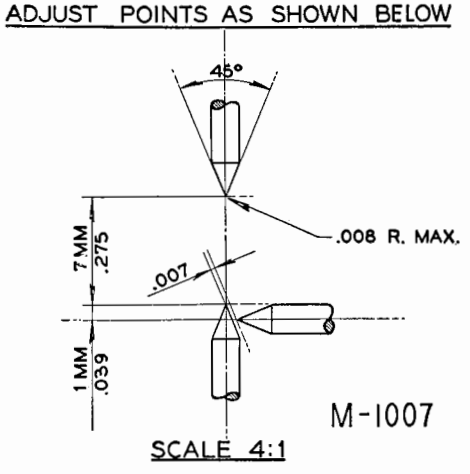


Fig. 24

If gaps and connections are found satisfactory, check the following.

1. Primary connectors for loose connections or partial shorts to ground.
2. Contact points for dirt or oil between surfaces.
3. Internal Timing of Magneto.
4. Magnetic strength of rotating magnet.
5. Primary condensers.
6. Timing of distributor heads and distributor electrode clearance.
7. Coil. Check as instructed below under "Coils".

High Speed Test

Run magneto for a few seconds at 3000 R.P.M. and observe sparks. If skipping occurs, test secondary condensers as instructed in this section. If secondary condensers are satisfactory, check internal timing of magneto. DO NOT OPERATE MAGNETO FOR AN EXTENDED TIME AT 3000 R.P.M.

Ground or Switch Terminals

Operate magneto at 3000 R.P.M. and check the ground or switch terminal outlets on each side of the magneto. When the primary current of either coil is short circuited through its ground terminal, sparking should not occur at the test gaps connected to this coil.

Rotating Magnet

The magnetic strength of the rotating magnet is checked by measuring the primary current output. Operate the magneto for about five minutes at 2500 R.P.M. During this run, short-circuit both coils simultaneously through their respective ground terminals thirty-five times. Then reduce the speed to 400 R.P.M. (drive shaft speed—must not vary more than 10 R.P.M. when checking primary current.) Hold contact points open by hand and connect ammeter No. 11–1124 across the open contacts and note current value. The reading at 400 R.P.M. should be 1.9 amperes or over. Check both breakers by this procedure. If the reading is below the required value on either breaker recheck primary condenser and primary connections for partial shorts to ground, loose connections, or other faults in assembling. If condenser and all connections are satisfactory, repeat test with a new coil. If current is still low, it will be necessary to disassemble magneto and recharge the magnet.

NOTE: *If it should be found necessary to disassemble the magneto and recharge the magnet, the indications are that the magnet did not receive a full charge when magnetized during the overhaul of the magneto. This means that the magnetizing equipment is not operating at required efficiency. The magnet charger switch contacts should be checked and the charger battery tested for full charge. The use of improper or defective magnetizing equipment can actually reduce the magnetic strength of the magnet instead of increasing it.*

Coils

The test of the coil must be made an actual running tes of the magneto on the test bench. Also, as heat affects the insulation materials of the coil, the test should be made at an elevated temperature. This is done by directing a reflector type heater on the magneto while it is being run on the test bench. When the temperature of the coil has reached approximately 165° F. (74° C.) the spark gaps should be increased by means of the adjustable panel from 7 m/m to 9 m/m. At 2000 R.P.M. the coil must spark consistently at this temperature and spark gap. Increase the gaps to 10 m/m. The coil should spark fairly consistently at this gap. However, intermittent missing with the 10 m/m gap is not cause to reject the coil.

It may be found that the coil produces consistent sparking at room temperature with the 7 m/m gaps; if the coil does not spark consistently at the elevated temperature with 9 m/m gaps it should not be used for further service.

Primary Condensers

The condenser should be tested before it is installed on the magneto. At locations where 110 Volt, 60 cycle, alternating current is available, use the No. 11–1767 Primary Condenser

Tester, in accordance with the instructions furnished with this tool.

Secondary Condensers

The secondary condenser must be tested before installation in the magneto. The tests to be made are covered in the following paragraphs:

CAUTION: *Always discharge the condenser by short-circuiting it with a piece of insulated wire before connecting it to any instrument, or handling it. This will eliminate possibility of shocks or damage to equipment.*

1. *Test for Capacitance at Low Voltage:*

a. Using a low voltage capacitance meter of good commercial accuracy, check the capacitance of the condenser. The condenser is acceptable if the capacitance is not less than .001 mfd. and not over .003 mfd. If the capacitance is outside these limits, reject the condenser.

2. *Insulation Resistance:*

a. Check the insulation resistance of the condenser dielectric, using a high voltage direct current tester capable of delivering 10,000 volts.

CAUTION: *Do not attempt to conduct this test with an A.C. tester.*

b. For this test the terminal block, containing the secondary condenser should be secured to a metal plate, so that the mounting screw inserts will be grounded to simulate operating conditions. A plate may be made for this purpose as shown in figure 25.

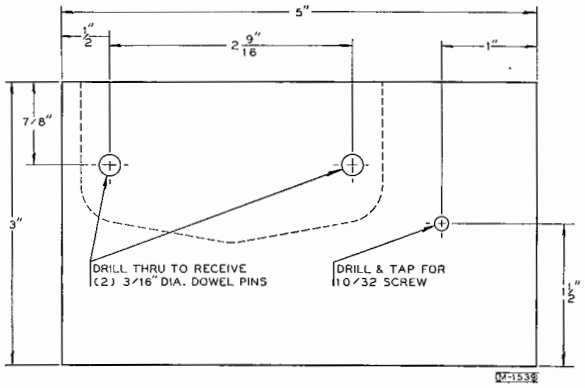


Fig. 25—Metal Plate for Testing

c. Make sure the high voltage D.C. tester is properly grounded, as covered in the manufacturer's instructions. Also ground the plate on which the condenser is mounted, by connecting a wire from the plate to the permanent ground terminal on the tester.

d. Clip high tension lead to an insulated screw driver and insert into high tension terminal hole in distributor block, making sure good contact is made with end of screw driver and insert in distributor block. Wind the piece of wire, which is grounded to the metal plate, around ground lead clip and clip lead to contact button hole in distributor block. (See figure 26.)

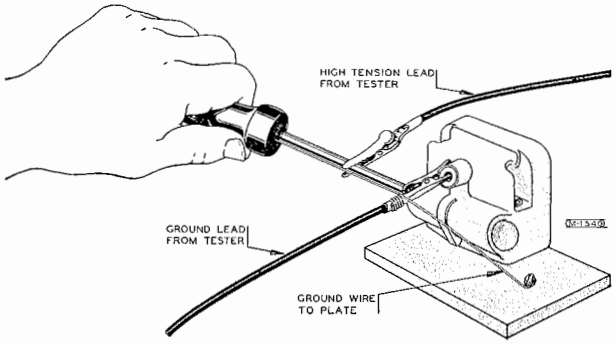


Fig. 26—Leakage Test (Contact Button Insert Grounded)

e. If the tester incorporates two resistance test ranges, set the range switch to "low". If two high voltage terminals are provided on the tester, use whichever terminal affords connection with the lowest internal resistor in the tester. If two current meter ranges are provided, use the high current range.

f. Turn on the tester and set the voltage control to deliver 10,000 volts, and then read the leakage current at this voltage. The current should not be in excess of that corresponding to 33 megohms insulation resistance of the condenser. Maximum permissible current readings, corresponding to the minimum permissible insulation resistance of 33 megohms, are listed below for the more common types of D.C. testers.

Make and Model	*Voltage Range and Meter Scale*	*Max. Permiss. Current*
TAKK Model 41		75 Microamperes
TAKK Model 55	Using Red H.V. Terminal and 500 Microampere meter scale	300 Microamperes
Delco No. 7244420	Using "Low" position of range switch	230 Microamperes
Slayter Model 33		.3 Milliamperes
B.G. Model M-652	Using High Scale Jack	230 Microamperes
B.G. Model M-660		300 Microamperes

g. If the leakage reading is greater than the maximum permissible reading listed above, the condenser is leaking excessively. However, further tests should be made before rejecting the condenser.

h. Discharge the condenser by short-circuiting it with a piece of insulated wire. Then reverse the connections of the ground and high voltage leads to the condenser as shown in figure 27 and repeat the same test. (Leave the condenser mounting plate grounded exactly the same as for the first test.) Again the leakage reading should not exceed that corresponding to 33 megohms.

NOTE: *The screw driver, as shown in dotted outlines, is not used when making the test but will be used when checking the performance at high voltage.*

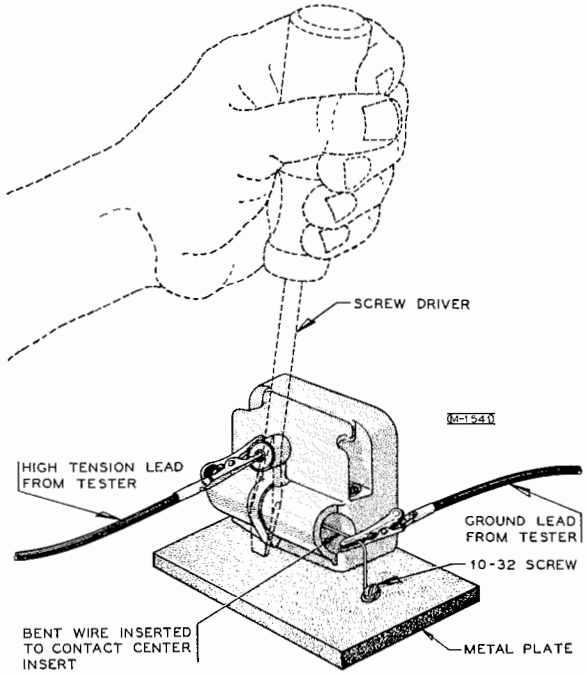


Fig. 27—Leakage Test (High Tension Terminal Socket Grounded)

i. If excessive leakage was indicated in either test, it might possibly have been due to surface leakage across the external dielectric surfaces. Carefully clean all external surfaces of the condenser. After cleaning, repeat the test. If the insulation resistance is still less than 33 megohms, reject the condenser.

3. Performance at High Voltage

a. Check the performance of the condenser at high voltage by observing its ability to produce a good lively spark when discharged across a 1/8 inch gap.

b. Performance Check Using a High Voltage D.C. Tester

1. A high voltage direct current tester can be used for making this test, provided that the instrument incorporates a high voltage output terminal with not over 10 megohms of internal limiting resistance. Testers which incorporate only a 100 megohm internal limiting resistor can not be used for this test because of the voltage-dropping effect of this resistor when connected to a condenser which has an insulation resistance at or near the lowest permissible service value of 33 megohms. With such a condenser connected to the tester, the voltage across the condenser would be below that required to ionize the 1/8 inch gap.

2. Hold the blade of the screw driver in contact with the metal plate and turn on the tester. Set the voltage control at 10,000 volts. Then move the shank of the screw driver so there is about a 1/8 inch gap between it and the clip on high tension lead. (See figure 27.) When this is done, there should occur a succession of snappy fat sparks across the 1/8 inch gap, showing that the condenser is charging and then discharging properly. If no sparks occur, check to see that the tester is producing the required output. If the tester is not producing adequate voltage, check tester. If gap will not deliver a hot fat spark with the condenser in the circuit, reject the condenser.

Final Inspection

After completing the running test of the magneto, and the test procedure as outlined above for the various factors affecting magneto operation, remove magneto from test bench and perform final check as follows:

1. Check to make sure contact points of each breaker open when straight edge coincides with timing mark. (See Service Chart.) Readjust contact points if it does not.
2. Check for evidence of leaking oil seals.
3. If housing, magnet, gears or cross shaft were replaced, remove gear cover and inspect teeth of large gear all the way around. Also it should be possible to feel a small amount of backlash at the loosest position of the gears even when lubricated. If this cannot be done, the indications are that some step of the assembly procedure was incorrectly performed, and the preloads and shimming should be rechecked.
4. After completing the final inspection, install the remaining parts to the magneto as instructed in the final paragraph of Section VI under "Completion of Assembly". If magneto is to be placed in storage, cover all terminal outlets with protector caps, and coat all unpainted external surfaces with an approved protective grease.

Testing the Magneto for Leakage with No. 11-1757 Flowmeter

NOTE: *To obtain accuracy and prevent damage, read this section carefully before using flowmeter.*

The leakage on the DF18R(L)N magneto, when tested on the test stand, should not be more than 20 cubic feet per hour as read on the lower scale on the chart. This test to be made while the magneto is operating.

Connect the flowmeter to the high tension terminal cap, which is provided with a tapped hole for the air inlet connection. Cap the other seven terminals to seal all air leakage.

Magnetos equipped with three plugs with .016 diameter orifices shall leak air at the rate from 10 min. to 20 max. cubic feet per hour.

Magnetos equipped with one .016 diameter plug and with altitude valves shall have the altitude valves replaced by solid pipe plugs firmly tightened. Under these conditions the magneto leakage shall not exceed 20 cubic feet per hour of standard air.

Magnetos equipped with altitude valves only shall have the altitude valves replaced by solid pipe plugs, firmly tightened. This test is used to determine the leakage of air around the gaskets, under the covers. The leakage shall not exceed 18 cubic feet per hour.

If the air leakage is excessive, check all cover screws, cover gaskets and terminal caps for tightness.

After a satisfactory reading has been obtained remove pipe plugs from breaker cover and install the altitude valves.

A. Using Flowmeter

(1) Turn reducing valve *R* (see illustration) to the left until it works loosely on its thread. This completely closes the valve.

(2) Attach an air supply hose to the nipple marked "IN" on the panel of the flowmeter.

(3) Attach open end of the hose supplied with flowmeter to the nipple marked "OUT" on the panel. The nipple at the other end of this hose is for attachment to the unit being tested. THE HOSE AND NIPPLE ARE PARTS OF THE INSTRUMENT. DO NOT SHORTEN OR LENGTHEN THE HOSE, AND DO NOT USE ANY OTHER HOSE OR NIPPLE. THE INSTRUMENT IS CALIBRATED TO USE THESE PARTS, AND ACCURACY MAY BE AFFECTED IF OTHERS ARE USED IN PLACE OF THEM.

(4) To connect the flowmeter to the unit which is to be tested, remove the supercharging supply pipe from unit, and connect in its place the nipple and hose from the "OUT" side of the flowmeter.

(5) Preliminary Check for Excessive Leakage.

IMPORTANT: *The pressure gauge of the flowmeter will be damaged if an attempt is made to measure a flow greater than the maximum range of the instrument on either the "HIGH" or "LOW" scale. To prevent such damage, the following preliminary check should be the first step in each test.*

(a) Place the range selector valve *S* (see illustration) in the "HIGH" position.

(b) Place the gauge control valve *C* in the "READ" position. (The illustration shows this valve in the "SET" position. The "READ" position is obtained when the handle of the valve is over the word "READ".)

(c) Slowly turn the regulator valve *R* to the right (Clockwise) until the pressure gauge reads 29. DO NOT UNDER ANY CIRCUMSTANCES RUN THE GAUGE BEYOND THE 30 MARK AS THIS WOULD DAMAGE THE GAUGE.

(d) With gauge reading 29, turn valve *C* to the "SET" position. This will normally decrease the reading of the gauge, somewhat, however, if the gauge reads less than 5 when valve *C* is placed in "SET" position, the leakage is more than the instrument can measure and the unit under test should be checked for defective or missing parts or faulty assembly before proceeding further.

(e) If the reading in "SET" position is above 5 on the gauge, it will be satisfactory to proceed with the measurement as follows:

(6) Leaving valve *C* in "SET" and valve *S* in "HIGH", turn the regulator valve *R* to the left until the gauge reads exactly 5. It is important that this setting be made accurately, therefore, tap the face of the gauge continuously when adjusting the regulator, to eliminate any tendency of the gauge to stick at one position.

(7) Leave the instrument in this position for a few seconds to make sure the reading does not change. If reading remains steady, turn gauge control valve *C* to "READ" position and note the reading on the gauge. Tap gauge as before to obtain accuracy.

(8) Turn valve *C* back to "SET" again to make sure the gauge still reads 5 at this position. Tap the gauge as before. If gauge does not read exactly 5, readjust regulator valve *R*.

(9) Turn valve *C* again to "READ", tap gauge, and note the gauge reading. Locate this reading on the *bottom* scale of figures on the chart in the cover of the instrument. Follow vertically upward from this point to the curved line marked "HIGH" on the chart. Then from this point follow horizontally to the left side of

the chart and read the flow in cubic feet per hour on the left hand scale.

(10) If the reading is too low for accuracy on the "HIGH" range, (less than 80 cu. ft. per hr.) use the "LOW" range. To do this, repeat the procedure starting with step No. 6 above, however, place range selector valve *S* in "LOW" position instead of "HIGH" and use the curve marked "LOW" on the chart when converting the reading to cu. ft. per hour.

PRECAUTIONS: *Do not run the gauge above the 30 P. S. I. mark, as this will stretch the bourdon tube and cause it to take a permanent set.*

B. Chief Causes of Overloading Gauge

(1) *IN* and *OUT* HOSES REVERSED.
(2) AIR LINE CONNECTED WITH REDUCING VALVE OPEN. THIS (VALVE IS OPEN WHEN THE KNOB IS SCREWED DOWN AND CLOSED WHEN IT IS LOOSENED.)
(3) ATTEMPTING TO MEASURE TOO MUCH LEAKAGE ON EITHER RANGE.
(4) CLOSING "OUT" HOSE COMPLETELY WITH AIR LINE TURNED ON AND REDUCING VALVE OPEN.

USE OF FITTINGS other than the HOSE and FITTING SUPPLIED will affect ACCURACY. Use the STANDARD ONE.

NUMERICAL SERVICE TOOL LIST

Present Tool No.	*Tool Name*	*Application*
11–740	Cam Setting Tool	For setting breaker cam.
11–825	Indicator	To check gear backlash.
11–851	Timing Light	To determine position where contact points open.
11–1124	Ammeter	For checking primary current.
11–1248	Contact Point Dressing Block (includes file 11–1256 and stone 11–1269)	To hold contact points securely while dressing surfaces.
11–1256	Contact Point File	For smoothing rough contacts.
11–1259	Straight Edge	For checking magneto timing.
11–1269	Contact Point Stone	For polishing the contact points.
11–1275	Assembly Tool	For assembling the contact assembly.
11–1287	Sleeve	To support front end plate in arbor press.
11–1303	Special Pulley	For testing magneto.
11–1343	Support Yoke	To support press fit bearing when removing from cross shaft.
11–1344	Puller	To remove breaker cam.
11–1362	Magnet Charger	To magnetize rotating magnet.
11–1413	Tap	For cleaning tapped holes in distributor head.
11–1471	Pressing Tool	To install press fit bearing to cross shaft. To press out magnet upper oil seal. To push out cross shaft bearing.
11–1472	Pressing Tool	To press in magnet upper oil seal. To push in magnet upper bearing.
11–1473	Bearing Pusher	To push in front end plate bearing.
11–1474	Timing Disc	To measure "E" gap and check internal timing.
11–1482	Pinion Remover	To remove the pinion gear.
11–1487	Spline Wrench	For drive shaft spline.
11–1488	Adaptors	Used with magnet charger.
11–1514	Pressing Tool	To remove or install front end plate oil seal.
11–1520	Spring	Used with timing tool.
11–1676	Pinion Height Gauge	For setting pinion gear.
11–1681	Tension Wrench	For tightening the breaker assembly screw.
11–1682	Tension Wrench	For tightening front end plate screws.
11–1684	Gauging Mandrel	Used with pinion height gauge.
11–1685	Preloading Tool Set (includes the following tools) 11–1603 Preloader for Rotating Magnet 11–1604 Preloader for Cross Shaft 11–1626 Plug Gauge for Preloader	For determining the shims required to give bearings proper preload.
11–1691	Reaming Fixture	To ream the magnet upper oil seal after installing in the housing.
11–1693	Plug Gauge	To check reamed hole after using No. 11–1691.
11–1735	Shaft Holding Wrench	To hold cross shaft.
11–1753	Tension Screw Driver	For tightening distributor head electrodes.
11–1757	Flowmeter	To check leakage of supercharged magnetos.
11–1767	Primary Condenser Tester	For testing the primary condenser.
11–1871	Gauge	To check thickness of platinum on contact points.
11–1959	Ball Bearing Grease Packer	To repack ball bearings with grease.
11–2731	Gauge	To check breaker spring tension.

ALSO REQUIRED

Test stand—18 cylinder, Hi-Lo Tension, Mfg; by Greer Hydraulics, 454 Eighteenth Street, Brooklyn 15, N. Y.

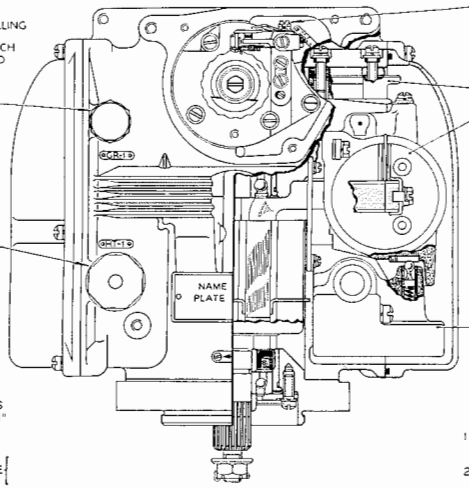
GROUND TERMINAL OUTLET "GR-1" IS CONNECTED TO SWITCH TERMINAL CONTROLLING DISTRIBUTOR HEAD CONNECTED TO "HT-1" TERMINAL "GR-2" IS CONNECTED TO SWITCH TERMINAL CONTROLLING DISTRIBUTOR HEAD CONNECTED TO "HT-2" TERMINAL OUTLETS ARE PROVIDED ON BOTH SIDES OF EACH COIL TO SUIT INSTALLATION REQUIREMENTS

HIGH TENSION TERMINAL OUTLETS MARKED "HT-1" AND "HT-2" ARE CONNECTED TO THEIR RESPECTIVE DISTRIBUTOR HEADS OUTLETS ARE PROVIDED ON BOTH SIDES OF EACH COIL TO SUIT INSTALLATION REQUIREMENTS

NOTE THE BREAKER ASSEMBLY ON THE NAME PLATE SIDE OF THE MAGNETO HOUSING OPERATES THE COIL WITH THE OUTLET MARKED "HT-2" THE OTHER BREAKER ASSEMBLY OPERATES THE COIL WITH THE OUTLET MARKED "HT-1"

† FOR CAM ROTATION SHOWN, THIS WILL BE
NO 1 BREAKER ON DF1BRN
NO 2 BREAKER ON DF1BLN

* FOR CAM ROTATION SHOWN, THIS WILL BE
NO 1 BREAKER ON DF1BLN
NO 2 BREAKER ON DF1BRN



SCREWS MUST BE TIGHTENED TO TORQUE VALUE SPECIFIED IN INSTRUCTIONS

CHECK EACH PRIMARY CONDENSER WITH # 11-1767 TESTER

CHECK PRIMARY CURRENT OF EACH COIL WITH AMMETER # 11-1124 VALUE AT 400 R.P.M. MUST BE 19 AMPS OR OVER

COMING-IN SPEED TESTED WITH 7 MM - 3 POINT GAPS 1120 R.P.M. MAXIMUM

HIGH TENSION TERMINAL BLOCK WITH SECONDARY CONDENSER DO NOT ATTEMPT TO REMOVE SECONDARY CONDENSER AS IT IS SEALED WITHIN THE TERMINAL BLOCK

FILL TO TOP OF CAM SHAFT WITH 2 1/3 OUNCES TEXACO REGAL STARFAX #2 (AAF 3560 E) GREASE

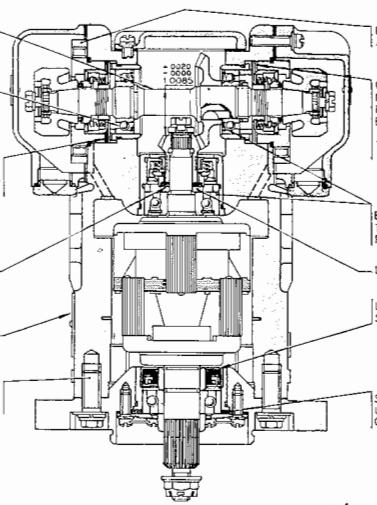
INNER RACE HAS A PRESS FIT ON BEARING SEAT OUTER RACE MUST HAVE A LIGHT PUSH FIT

SHIMS OF CAM SHAFT BEARINGS USE PRELOADING FIXTURE # 11-1604 TO OBTAIN 60 ± 15 LB PRELOAD ON BEARINGS

SHIMS FOR ADJUSTING PINION

NAME PLATE

SCREWS MUST BE TIGHTENED TO TORQUE VALUE SPECIFIED IN THE INSTRUCTIONS



BREAKER PLATES WITH GITS OIL SEAL ARE ASSEMBLED PARTS.

USE PRELOADER # 11-1604 TO DETERMINE QUANTITY OF SHIMS REQUIRED FOR PROPER GEAR BACKLASH. BACKLASH MUST NOT BE LESS THAN .001" AT TIGHTEST POSITION NOR MORE THAN .005" AT LOOSEST POSITION. (SEE INSTRUCTIONS)

BOTH INNER AND OUTER RACES OF THIS BEARING MUST HAVE A LIGHT PUSH FIT.

LAPPED WASHER

LEATHER OF NEW OIL SEALS MUST BE SOAKED IN S.A.E. #40 OIL BEFORE INSTALLING

SHIMS FOR ROTATING MAGNET BEARINGS USE PRELOADING FIXTURE # 11-1603 TO OBTAIN 60± 15 LB PRELOAD ON BEARINGS.

Timing of Distributor Finger

1. ADJUST DISTRIBUTOR FINGER SO THAT ITS HIGH TENSION SEGMENT IS OPPOSITE THE NO 1 DISTRIBUTOR HEAD ELECTRODE WHEN THE PISTON OF NO 1 CYLINDER IS IN ITS FULL ADVANCE FIRING POSITION.
2. FOR MAGNETOS HAVING A LARGE NO 1 "E GAP" (17°), THE TRAILING HALF OF THE HIGH TENSION SEGMENT MUST BE OPPOSITE THE NO 1 DISTRIBUTOR HEAD ELECTRODE. MAGNETOS WITH A SMALL NO 1 "E GAP" (9°) MUST HAVE THE LEADING HALF OF THE SEGMENT OPPOSITE NO 1 HEAD ELECTRODE. THE SKETCH SHOWS RELATION FOR AN INTERMEDIATE "E GAP" SUCH AS 12°

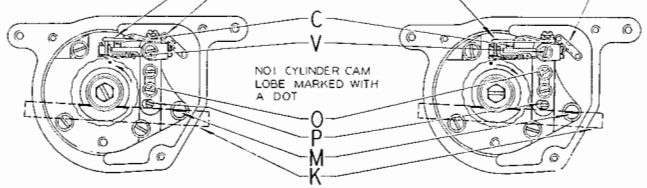
TIMING OF CAMS

DURING OVERHAUL PERIOD

A. MAGNETOS WITH TIMING MARK
1. LOCK ROTATING MAGNET IN NO 1 "E GAP" POSITION. THIS IS DETERMINED BY USING TIMING DISC # 11-1474 AND TURNING MAGNET PAST NEUTRAL THE NUMBER OF DEGREES STAMPED ON CAM.
2. SET EACH CAM BY MEANS OF VERNIER ADJUSTMENTS PROVIDED BY RATCHETS UNTIL STRAIGHT EDGE PLACED ON STEP OF CAM COINCIDES WITH TIMING MARK ON BREAKER PLATE POST.

B. MAGNETOS WITHOUT TIMING MARK
1. ADJUST CONTACT POINTS SO THAT THEY WILL REMAIN OPEN ON NO 1 LOBE THE NUMBER OF DEGREES SPECIFIED IN INSTRUCTION BOOK FOR EACH TYPE OF CAM.
2. LOCK ROTATING MAGNET IN NO 1 "E GAP" POSITION
3. SET CAM BY MEANS OF VERNIER ADJUSTMENTS PROVIDED BY RATCHETS SO THAT CONTACT POINTS JUST BEGIN TO OPEN ON THE NO 1 LOBE. USE TIMING LIGHT # 11-851 OR EQUIVALENT
4. WITH CONTACT POINTS JUST OPENING ON NO 1 LOBE, INSCRIBE TIMING MARK ON BREAKER PLATE POST IN LINE WITH STRAIGHT EDGE PLACED AGAINST STEP OF CAM
5. CHECK CAM LOBES SPECIFIED IN INSTRUCTION BOOK FOR MINIMUM "E GAP" AND TO MAKE SURE THE CONTACT POINTS CLOSE AT THE REQUIRED NUMBER OF DEGREES BEFORE NEUTRAL AS MEASURED ON THE MAGNET SHAFT. ALSO CHECK SYNCHRONIZATION OF THE CAMS

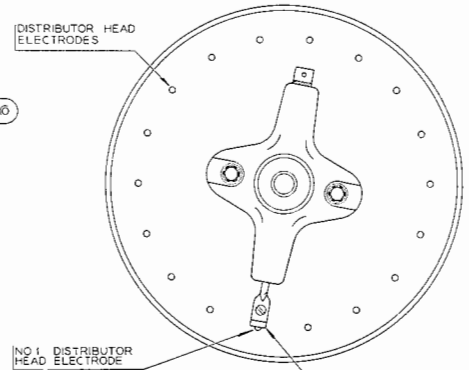
MINIMUM TENSION 15 OZ USE GAUGE # 11-2731 NEW MAIN SPRINGS HAVE 20 TO 32 OZ TENSION.



ADJUSTMENT OF CONTACT POINTS

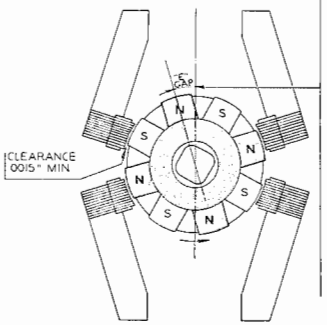
DO NOT USE A FEELER GAUGE
CONNECT TIMING LIGHT # 11-851 OR EQUIVALENT ACROSS EACH SET OF CONTACT POINTS LOOSEN SCREWS "O" AND TURN ECCENTRIC "P" UNTIL CONTACT POINTS JUST BEGIN TO OPEN ON THE NO 1 LOBE WHEN A STRAIGHT EDGE PLACED AGAINST STEP OF CAM COINCIDES WITH TIMING MARK "M"

IMPORTANT DO NOT ADJUST CONTACT POINTS FOR A FIXED CLEARANCE NEVER USE A FEELER GAUGE BETWEEN THE POINTS



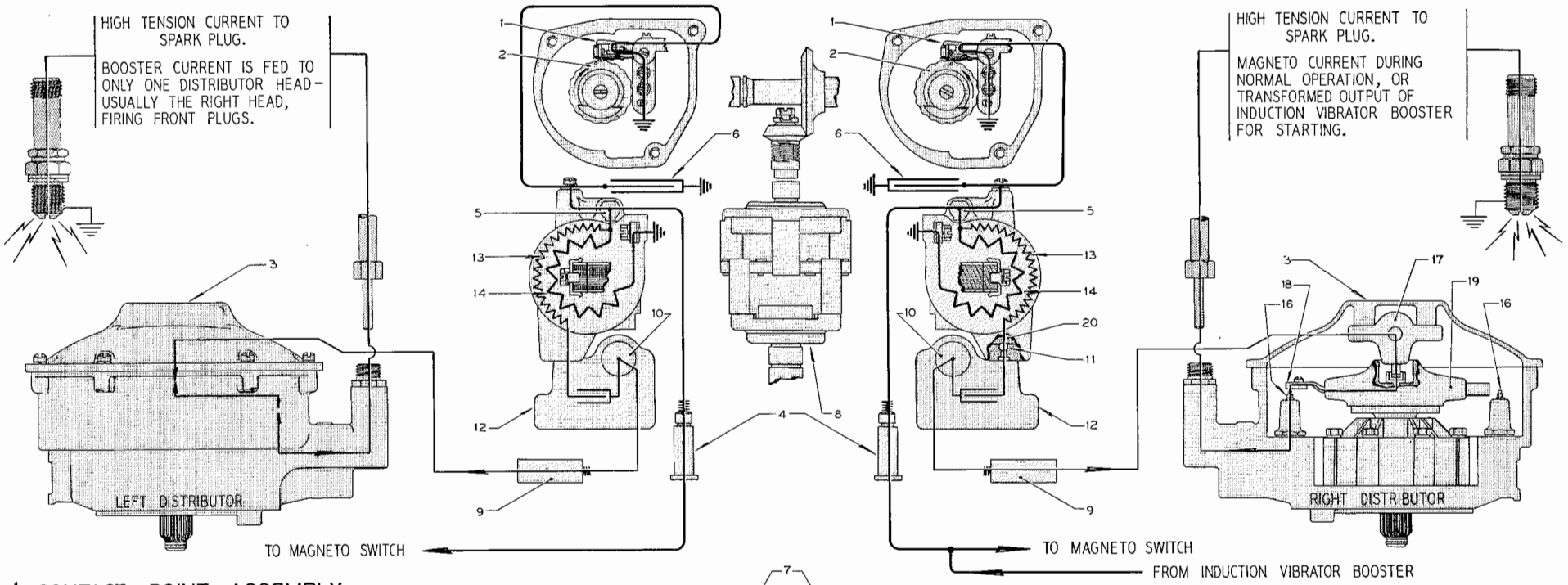
IMPORTANT DO NOT CHANGE TIMING OF CAM OR LOOSEN CAM SECURING SCREW BETWEEN OVERHAUL PERIODS

DISTRIBUTOR FINGER REPLACEABLE HIGH TENSION SEGMENT



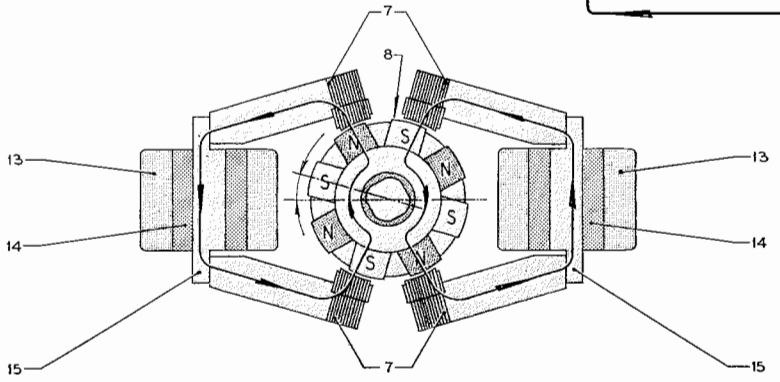
M-1542

SERVICE CHART
DF1BRN & DF1BLN MAGNETO
SCINTILLA MAGNETO DIVISION


HIGH TENSION CURRENT TO SPARK PLUG.
BOOSTER CURRENT IS FED TO ONLY ONE DISTRIBUTOR HEAD - USUALLY THE RIGHT HEAD, FIRING FRONT PLUGS.
HIGH TENSION CURRENT TO SPARK PLUG.
MAGNETO CURRENT DURING NORMAL OPERATION, OR TRANSFORMED OUTPUT OF INDUCTION VIBRATOR BOOSTER FOR STARTING.
LEFT DISTRIBUTOR
RIGHT DISTRIBUTOR
TO MAGNETO SWITCH
TO MAGNETO SWITCH
FROM INDUCTION VIBRATOR BOOSTER

1. CONTACT POINT ASSEMBLY
2. BREAKER CAM
3. DISTRIBUTOR ASSEMBLY
4. GROUND TERMINAL
5. PRIMARY INSERT IN COIL HOUSING
6. PRIMARY CONDENSER
7. POLE SHOES IN MAGNETO HOUSING
8. ROTATING MAGNET
9. HIGH TENSION TERMINAL
10. HIGH TENSION CONTACT IN TERMINAL BLOCK
11. CONTACT BUTTON IN TERMINAL BLOCK

(M-1543)



12. TERMINAL BLOCK WITH SECONDARY CONDENSER
13. SECONDARY WINDING OF COIL
14. PRIMARY WINDING OF COIL
15. COIL CORE
16. DISTRIBUTOR ELECTRODE
17. TERMINAL BLOCK IN DISTRIBUTOR COVER
18. DISTRIBUTOR FINGER ELECTRODE
19. DISTRIBUTOR FINGER
20. HIGH TENSION INSERT IN COIL HOUSING

SCHEMATIC DIAGRAM OF ELECTRIC AND MAGNETIC CIRCUITS

SERVICE INSTRUCTIONS

BENDIX-SCINTILLA
ALTITUDE VALVE

10-31173-1

SCINTILLA MAGNETO DIVISION
BENDIX AVIATION CORPORATION
SIDNEY, NEW YORK, U. S. A.

PRINTED IN U.S.A.

FORM L-222

SECTION I

DESCRIPTION

1. The Bendix-Scintilla Altitude Valve is an automatic pressure-venting device for use on pressurized high tension ignition systems. The valve serves as a ventilator when the system is being operated on the ground or at low altitudes where pressure is not required. At high altitudes, the valve automatically closes, preventing the escape of air from within the system and thus maintaining the necessary air pressure for proper performance.

2. The operating principle of the valve is depicted in Figure 1 which is a cross-sectional view showing the internal construction. The valve consists of a permanently sealed air cell "E", one wall of which is a rubber diaphragm "D". This diaphragm is directly over the rim "C" of the outlet passage, through which air escapes from the magneto. This air then passes out of the holes "B" on the body of the valve.

3. At high altitudes, the lowered atmospheric pressure of the outside air results in a lowered pressure in the chamber "A", under all portions of the diaphragm. By reason of the lowered pressure under the diaphragm, the sealed-in sea-level-pressure air in the cell expands and pushes the diaphragm down closer to the rim "C". This restricts the flow of escaping air and tends to maintain the pressure in chamber "A". As higher altitudes are reached this action increases, tending to be self-regulatory, and to maintain a constant safe operating pressure on the pressurized parts of the ignition system for all altitudes at which the aircraft is designed to fly.

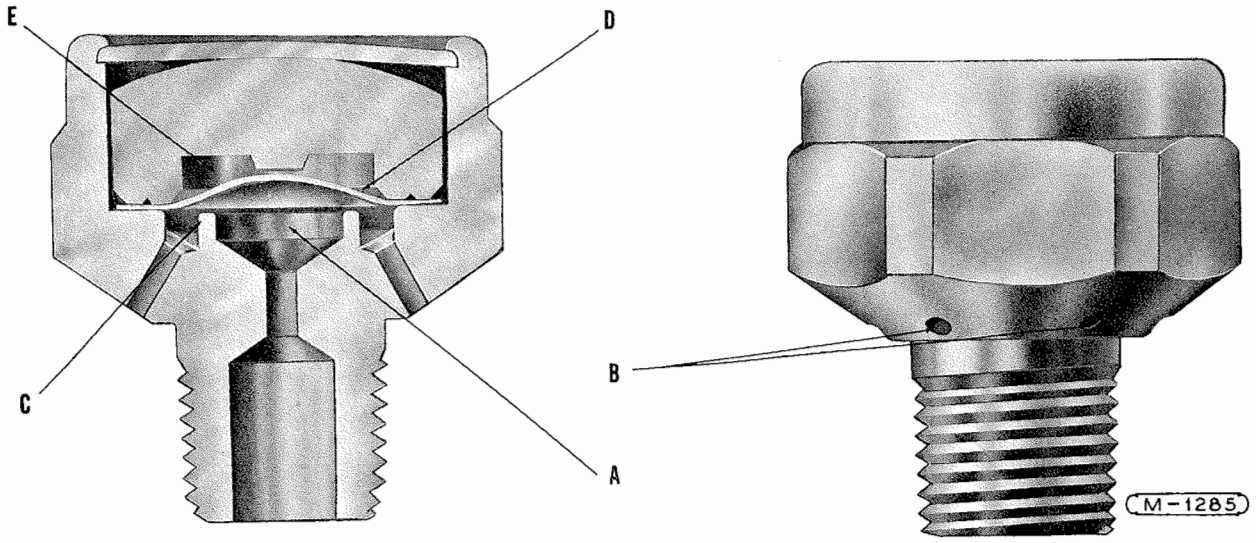


Figure 1
View of Sectional and Complete Altitude Valves

SECTION II

MAINTENANCE

1. Under normal conditions the altitude valves require no maintenance between engine overhauls.

2. In general there are only two things that can go wrong with the valve; first, plugging; and second, leaking air cell. Since there are several valves on each ignition system neither of these troubles will have a very pronounced effect on engine performance unless they exist on a majority of the valves on the system.

3. Plugging may affect the closing of the valve by interfering with the full travel of the diaphragm. In this instance the symptom would be roughness due to flashover at high altitude, but with no effect on operation at low flying levels.

4. Leakage of the sealed air cell would result in failure of the valve to remain closed, were the system operated for extended intervals at high altitude. Should all valves be subject to this trouble the effect would be a loss of pressure, and at extremely high altitudes this might allow flashover to occur, causing roughness.

5. If either of these engine troubles should be experienced, all valves of the system should be replaced and the suspected units turned over to the shop for cleaning and test.

SECTION III

CLEANING

1. Suspected valves should be cleaned by soaking in clean unleaded gasoline for about 1/2 hour, followed by blowing with compressed air applied through the shank of the valve, and using a pressure of not over 20 pounds. If necessary this operation may be repeated in order to thoroughly clean the valve.

Caution: *Do not immerse the valve in acetone, lacquer thinner, or any other highly active solvents or cleaners, as they might attack the impregnating medium of the valve diaphragm and cause it to leak. Note in Figure 1 that the valve diaphragm lies directly over all the holes in the valve body. Therefore,* under no circumstances should any wire or other sharp instrument be inserted into any of the holes in the valve *due to the danger of puncturing the diaphragm.*

SECTION IV

ALTITUDE VALVE TEST

1. GENERAL INFORMATION

a. Test procedures for the altitude valve are based upon the two possible causes of failure discussed in Section II, and consist of:

(1) Test for proper air flow at ground-level pressures.

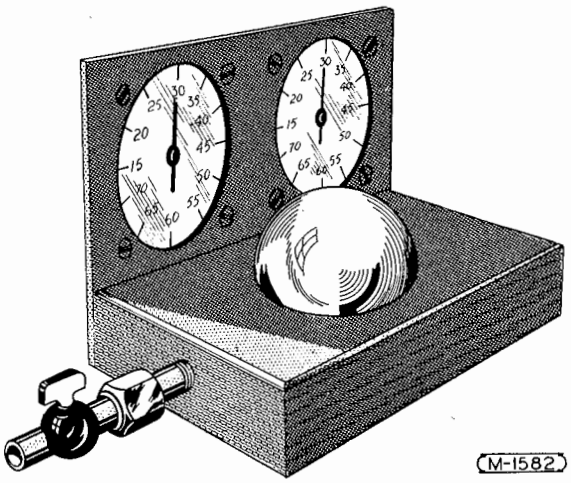


Figure 2
Front View of Suggested Test Figure 11-3200

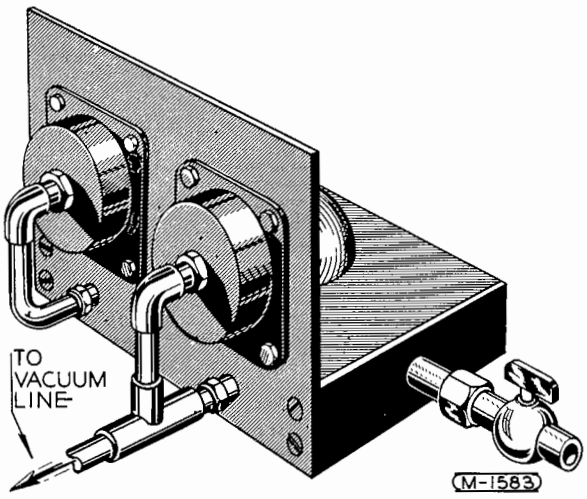


Figure 3
Rear View of Suggested Test Fixture 11-3200

(2) Test for proper closing and ability to retain air pressure at altitudes.

2. TEST EQUIPMENT

a. Both the ground and altitude tests can be conducted with a practical test apparatus which will be sufficiently accurate for this purpose. This fixture may be purchased direct from the factory under our Part No. 11–3200 or may be constructed in the average shop. The equipment is shown in Figures 2 and 3. It consists of a valve holding fixture, two standard gages and a special calibrated orifice which is available from the factory under Part No. 11–3201. Detail drawings of the fixture are available from the factory.

b. Figure 4 is a schematic sketch of the piping connections of the test fixture. Operators designing their own fixture may deviate from the details of this design somewhat without upsetting the accuracy of the test as the general requirements are not critical. However, it is desirable to keep all the drilled passages or piping connections as short as possible and to have all passages at least 1/8″ in diameter.

c. Regardless of fixture design, the No. 11–3201 orifice should be procured in any case, since the accuracy of this orifice test depends directly upon the accuracy of this orifice. The No. 11–3201 orifice is calibrated to flow 2-1/2 cubic feet per hour of standard air with a standard sea-level atmosphere of 29.92″ hg. absolute on the open end and a vacuum of 5 inches of mercury (24.92″ hg. absolute) on the threaded end.

Note: *The altitude valve is neither designed nor required to function as a precision device. Being to a great extent self-regulatory, a fairly wide variation is permissible in its performance when tested as an individual unit. Further, valve operation is affected by temperature and barometer readings, and accordingly test results for a particular valve may be found to vary slightly from one time to another. However, due to the number of valves in use on the ignition system these individual variations will counteract one another when the parts are in operation on the engine. There are a number of factors which are related to the valve in their overall effect on engine performance, such as the pump output, total ignition system leakage through joints and piping, and the spark plug gap settings, all of which introduce variations in the average requirements for a given group of valves installed on an engine. The rejection limits given for the tests which follow are based up-*

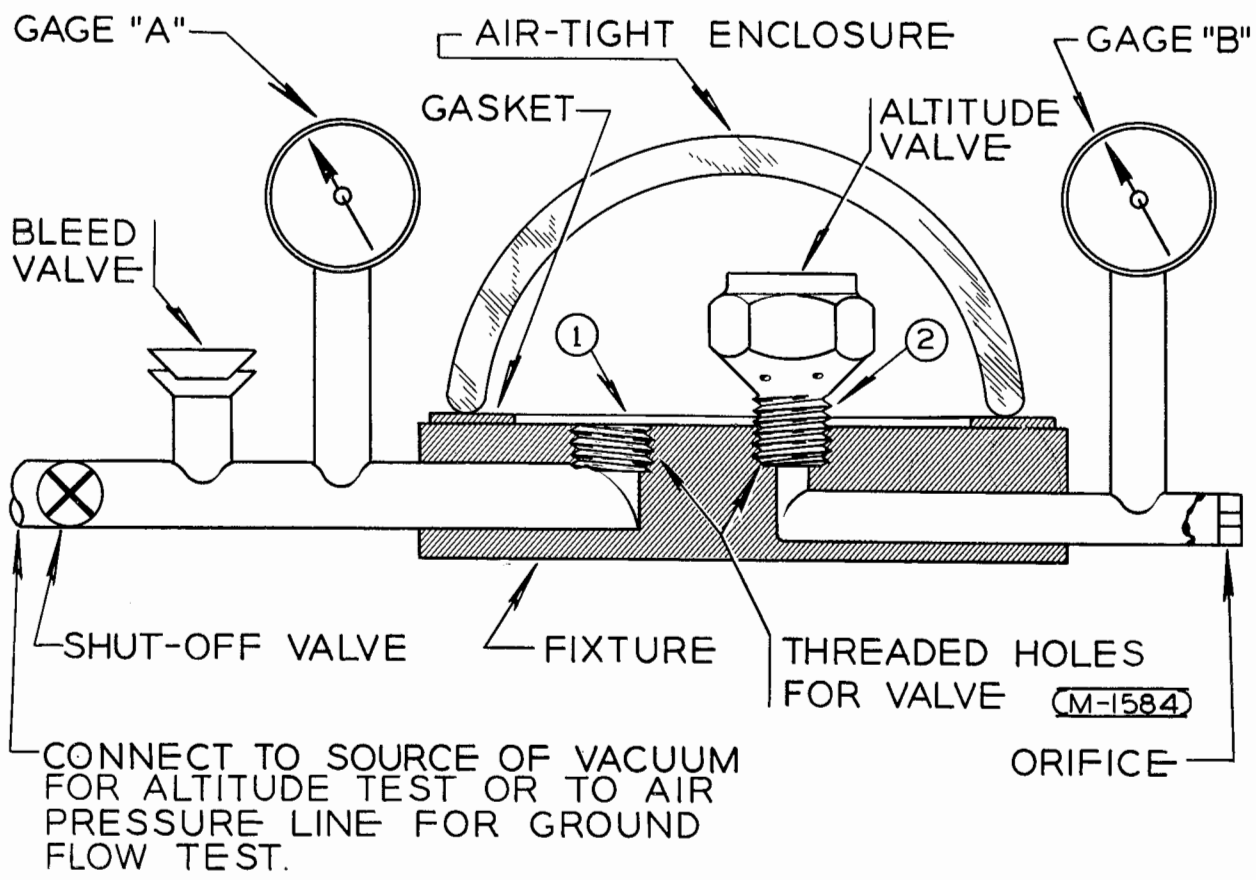


Figure 4
Schematic Layout of Test Fixture 11-3200

on the assumption that all related factors are operating at the most unfavorable limit of their tolerances and therefore the test limits provide a wider margin of safety than is necessary in an average case. For this reason valves which test at or slightly beyond the rejection limit should be classed as questionable rather than as definite rejects. Such valves will give satisfactory performance under average engine conditions, and may, when tested under conditions of higher temperature or lower barometer readings, even pass the individual tests satisfactorily.

3. TEST PROCEDURE

a. Ground Test

(1) Flow testing of the valve at ground pressure is based upon the fact that the normal air flow of the complete valve when open is approximately the same as that of an orifice the size of the hole in the valve shank. The test is made by comparing the flow of the valve being tested with that of a standard valve shank from which the internal parts have been removed.

(2) File off the rolled bead at the top of the head of a discarded valve, releasing the disc, block, and diaphragm from the valve. (See figure 5.) The internal parts can be scrapped, because only the valve body is needed for the test. Check the valve body to make sure the center hole through the shank is open and clean. Do not enlarge or change the diameter of the hole in the valve shank.

(3) Connect an air line to the shut off valve of the fixture (See figure 4.). Close the shut-off valve and the bleed valve. Screw the prepared valve shank (with internal parts removed) into the threaded hole "1" (Figure 4) in the fixture. DO NOT PLACE THE ENCLOSURE OVER THE VALVE AS THE LATTER MUST BE OPEN TO THE ATMOSPHERE FOR THIS TEST.

(4) With the adjustable valve closed, turn on the air at the main line. Then carefully open the adjustable valve until gage "A" reads 2 inches of mercury above the normal atmospheric pressure.

Caution: *Do not open the adjustable valve too rapidly as excessive pressure may damage the gage "A".*

(5) With the adjustable valve set to maintain a pressure of 2 inches of mercury above the normal atmospheric pressure, remove the prepared altitude valve from the fixture. The valves to be tested may now be checked by screwing each one in turn into the threaded hole No. 1 of the fixture.

(6) When a valve is screwed into the hole for test, the "A" gage reading should not rise beyond 3 inches above normal atmosphere. Should the reading increase to more than 3 inches above normal atmosphere, the valve is obstructed and will not provide the necessary ventilation of the system when in operation on the engine.

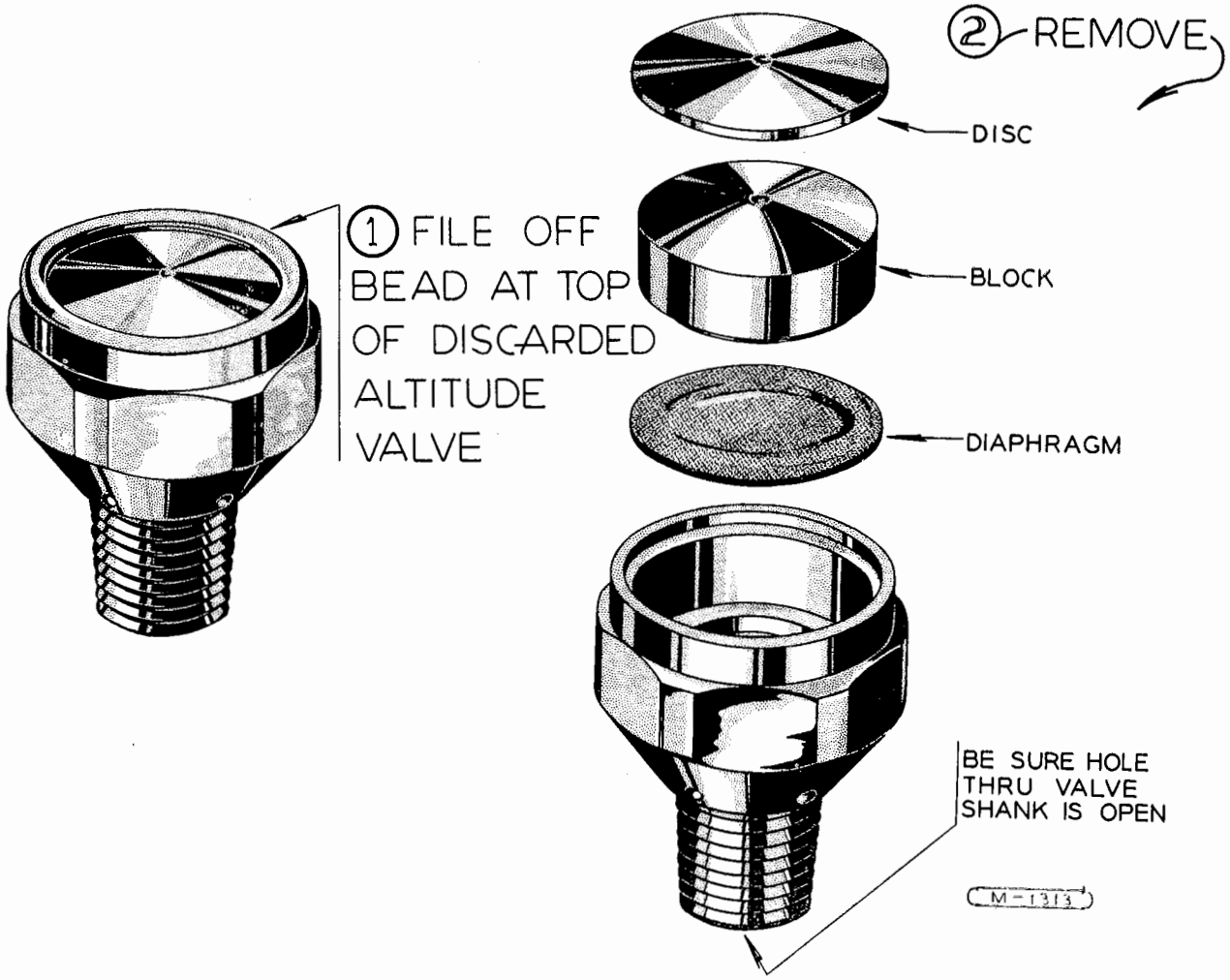


Figure 5
Preparation of Discarded Valve for Use in Airflow Test

Caution: *When inserting the valves, keep watch of the gage to prevent damage to it in the event that a completely plugged valve is inserted. If the pressure goes beyond 3 inches above atmosphere when starting the valve into the hole, do not tighten it fully or the gage may be damaged. Reject the valve.*

(7) A valve rejected on this test should be cleaned as previously instructed, and retested. If cleaning does not correct the trouble the valve should be scrapped.

Note: *Any valves which give out a whistle when subjected to this test, should be rejected, regardless of the reading.*

b. Test for Proper Closing and Ability to Retain Air Pressure

(1) The test of the ability of the valve to close properly and retain air pressure affords an indication of the performance of the valve at high altitude. This test is accomplished by applying lowered pressure (vacuum) to the body of the valve until it closes, and then observing the leakage through the valve when closed. Leakage measurements are made in terms of the pressure drop produced across the No. 11–3201 orifice.

(2) Connect the test fixture to a source of vacuum, having the shut-off valve closed and the bleed valve open. (See figure 4.)

(3) Apply a small amount of heavy grease to the threads of the valve which is to be tested and screw it finger-tight into threaded hole "2" in fixture. Place the air-tight enclosure over the valve. Open the shut-off valve.

Note: *The weight of the valve enclosure or chamber cover should be sufficient to seal against the gasket. However, it may be best to press the enclosure down when first applying vacuum. Then when the vacuum has reached 20 inches, atmospheric pressure will hold the enclosure down tightly enough to provide an air-tight seal.*

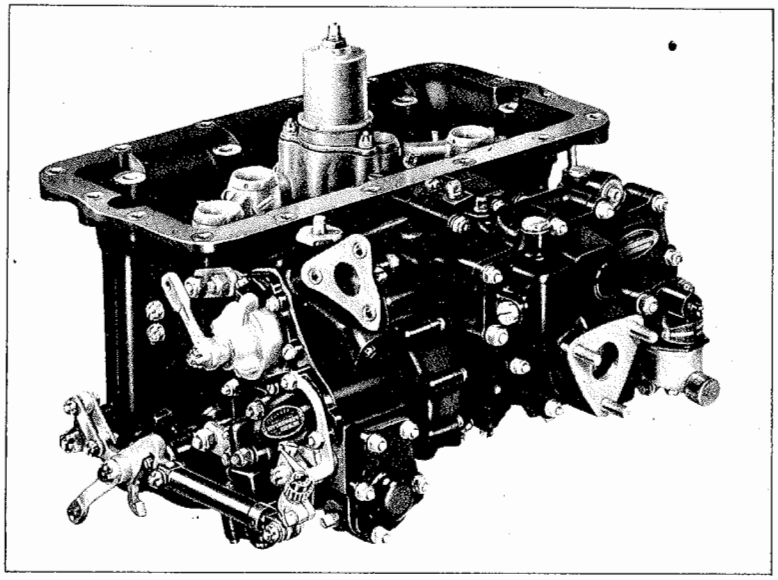
(4) Close the bleed valve slowly, at the same time tapping on gage "A" lightly to overcome any tendency of the gage needle to stick. Adjust the bleed valve accurately until gage "A" reads 20 inches of mercury below the prevailing atmospheric pressure.

(5) Tap gage "B" lightly as previously instructed to make it read accurately. Allow about 30 seconds in which to observe any change in the reading of gage "B". For a valve which closes perfectly the gage "B" will read the normal atmospheric pressure. Valves having slight leakage will show a reading below normal atmospheric pressure. Observe the reading of gage "B". If the difference between this reading and the normal atmospheric pressure is more than 6 inches, the valve is leaking excessively.

(6) Should it happen that the gage "B" does not come to rest but shows a steadily decreasing pressure, prolong the test until the gage needle comes to rest. "Creeping" of the gage in this manner indicates a slow leak in the air cell of the valve, and the latter is definitely defective and should therefore be rejected.

Instructions on Stromberg PR-58E5 Injection Carburetors

(Supersedes Form 10-833, dated 5-6-46)



a. GENERAL

1. The Stromberg PR-58E5 Injection Carburetor, as used on Pratt and Whitney R-2800 series engines, is a rectangular barrel, downdraft Unit. It incorporates a "Fuel Head" Enrichment Valve, Constant Head Idle Spring, Constant Effort Spring, an Automatic Mixture Control Unit, a throttle actuated Accelerating Pump, Throttle Balance, Stromberg Electric Primer Valve, and a Derichment Valve. Provision is made in the carburetor for delayed action of the Enrichment Valve and for use of an Automatic Spark Advance Control Unit.

2. The Regulator Unit incorporates both a Constant Head Idle Spring and a Constant Effort Spring which are designed to maintain a constant fuel metering head in the idle range at low air flows. During this idle range, a small diameter helical spring between the telescoping parts of the poppet valve stem, and a larger diameter helical spring operating on the air diaphragm open the poppet valve to a predetermined degree until the air metering force is equal to the force of the small spring. At any air flow above this point, the two telescoping parts of the poppet valve stem make solid contact and function as a unit under all higher air flows in the same manner as the conventional rigid-type poppet valve stem assembly. The small diameter constant head spring eliminates need for the lever-type spring. The larger constant effort spring, which exerts a much lower spring force, provides for smooth transfer from idle to low power cruise operation.

3. The derichment valve is incorporated in the Fuel Control Unit jet cover and consists mainly of a diaphragm operated needle valve and a derichment jet. The combined fuel flow through the derichment jet and power enrichment jet is approximately equal to the flow through the power enrichment jet used in carburetors without the derichment valve system. When water pressure is applied on the derichment valve diaphragm, the needle valve closes and shuts off the fuel flow through the derichment jet. This reduces the fuel/air ratio to the "best power" mixture for "War Emergency Power" which requires the use of the water injection system. At this time sufficient water is injected into the engine with the fuel to restore the liquid/air ratio to the original value. When the water injection system is not in operation, the derichment valve remains open and normal fuel/air ratios are maintained.

4 The principles of operation of the Stromberg PR-58E5 Injection Carburetor are in general the same as those illustrated in the schematic diagram, figure 11.

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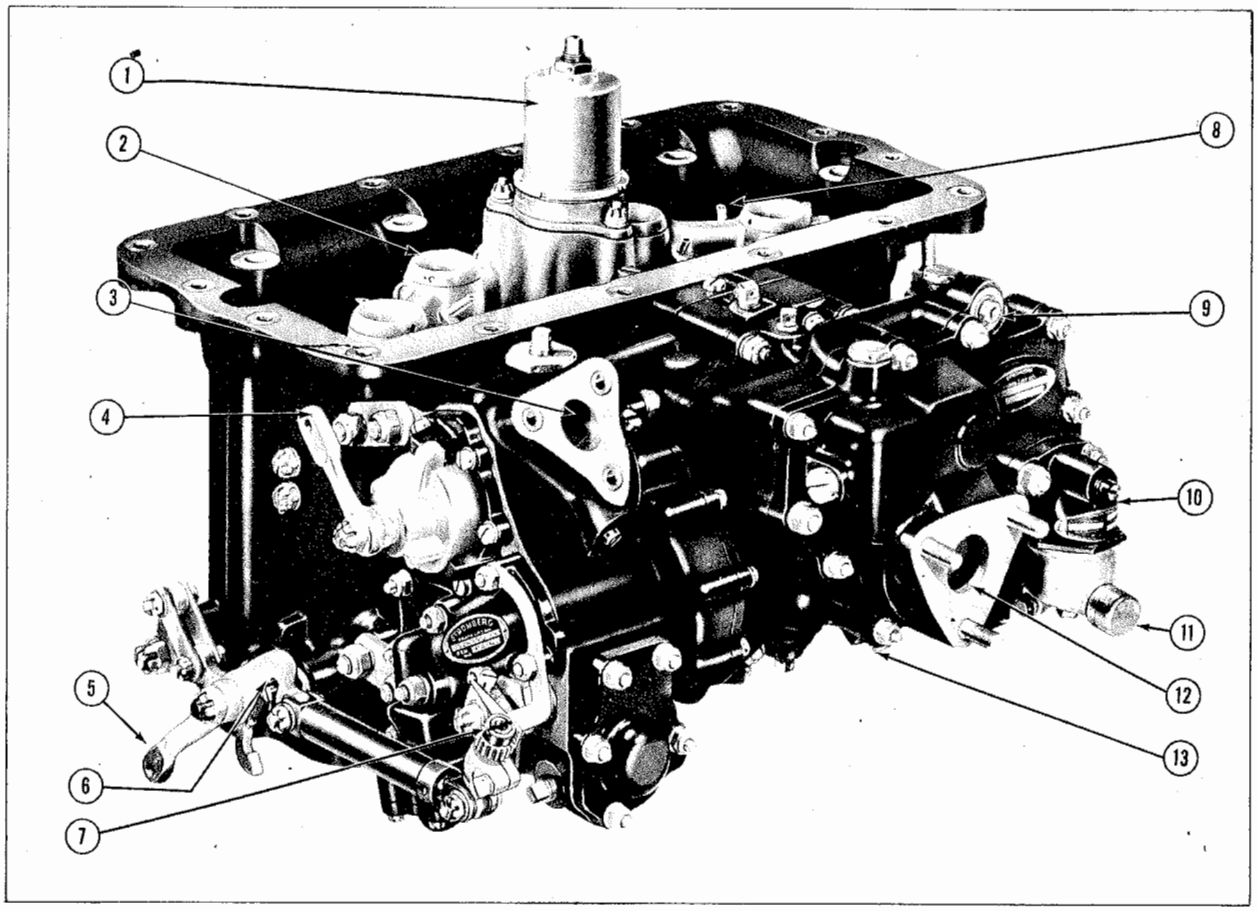
Bendix Aviation Corporation
South Bend 20, Indiana



1. **Automatic Mixture Control Unit**
2. **Boost Venturi Tube**
3. **Fuel Transfer Tube Mounting Flange**
4. **Manual Mixture Control Lever**
5. **Throttle Lever**
6. **Idle Speed Adjustment**
7. **Idle Mixture Adjustment**
8. **Impact Tube**
9. **Vapor Vent Connection**
10. **Primer Valve Fuel Line Connection**
11. **Primer Valve Electrical Connection**
12. **Fuel Inlet**
13. **Fuel Pressure Gage Connection**

FIGURE 1 — STROMBERG PR-53E5 INJECTION CARBURETOR

b. INSTALLATION—See Figure 1

1. Fasten the carburetor to the engine mounting flange with the proper gasket in place and with the fuel inlet pad (12) to the rear.

2. Connect the fuel supply line from the engine fuel pump to the fuel inlet connection (12) located on the Regulator rear body cover. Connect the vapor return line from the engine fuel tank to the 1/8" pipe tap vapor vent connection (9). Attach the fuel transfer line from the discharge nozzle to the triangular pad (3) on the Fuel Control Unit. Connect the line from the fuel pressure gage to the 1/8" pipe tap connection (13) in the bottom of the Regulator rear body.

3. Connect the water pressure line from the water injection system to the 1/8" standard pipe tap connection in the derichment valve cover on the Fuel Control Unit.

4. The throttle lever (5) has a travel of 75° and requires a control rod movement of 2.4375", and the manual mixture control lever (4) has a travel of 90° requiring a control rod movement of 2.8125". Both levers are adjustable radially in 15° increments to conform to the control system of the airplane. It is essential that the control rods permit full travel of both the throttle and manual mixture control levers.

5. Connect the lead wires from the pilot's Primer switch to the 3/4"-20 electrical connection (11) and the fuel line from the engine primer nozzles to the 1/8" pipe tap connection (10).

6. Sufficient space must be provided for removal and cleaning of the fuel strainer. Space must also be provided to permit making idle mixture (7) and idle speed (6) adjustments while the engine is running.

c. OVERHAUL

1. In general, this carburetor can be disassembled, overhauled and assembled by referring to the Stromberg Injection Carburetor Overhaul Manual, Form 10-1142, and figures 2 through 10 included in these instructions. The index numbers on all exploded views are so arranged that in most instances the disassembly of the carburetor into its component parts can be started by removing the part on each figure bearing the highest index number; then removing all other parts in descending numerical order. To assemble, begin with the lowest index number and assemble the parts in ascending numerical order. In normal overhaul, it will be unnecessary to remove studs, threaded bushings or other parts which are pressed or pinned in place. However, should it be necessary to remove the foregoing parts, it is recommended that they be replaced with a designated oversize part. The numbers for these oversize parts are listed on the Parts List applicable to the Unit being overhauled.

2. In addition to the instructions given in the Overhaul Manual, Form 10-1142, the individual units can be disassembled and reassembled as described in the following paragraphs, after separating the Regulator Unit from the Fuel Control Unit:

(a) REGULATOR UNIT—See Figure 5.

1. Disassembly — To disassemble the Regulator Unit, follow in descending numerical order the procedure shown in exploded views and described below. In order to avoid twisting the diaphragm, be sure to use special tool T-25170 when separating the poppet valve adjusting screw assembly (62) from the spacer and shaft assembly (56). Use special socket T-25168 for removing hold-down nut (50) in front body. Use fixture T-25303 and special fixture T-25169 when removing nut (48) from idle spring bushing (32). The use of this T-25169 fixture is illustrated in figure 2.

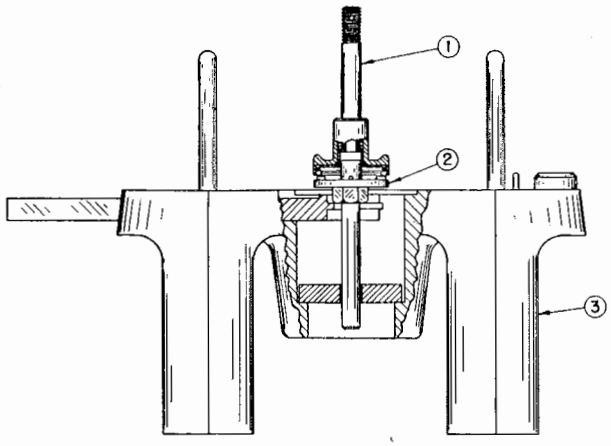
2. Assembly

a Front Body

(1) Place front body (1) on bench with small diameter down. Install bleeds (3), (4) and (5). Assemble in order shown: gasket (8), plate (9), diaphragm (10), retainer plate (11), and large washer (12). Install and tighten the six fillister head screws (13). Lockwire the six screws.

b Center Body

(1) Install bleed (18) and plug (19). On the center body (14) assemble the gasket (23), plate (24) or spark advance control unit, if used, washer (25), nuts (26) and cotter pins (27). Assemble in center body as shown, diaphragm (28), gasket (29), retainer plate (30) and fasten with the six fillister head screws (31); lockwire these screws. Next, assemble as a unit, the guide bushing (32), spring (33), spring guide bushing (34), guide (35) and snap ring (36).



1. Idle Spring Bushing
2. T-25169 Fixture
3. T-25303 Fixture

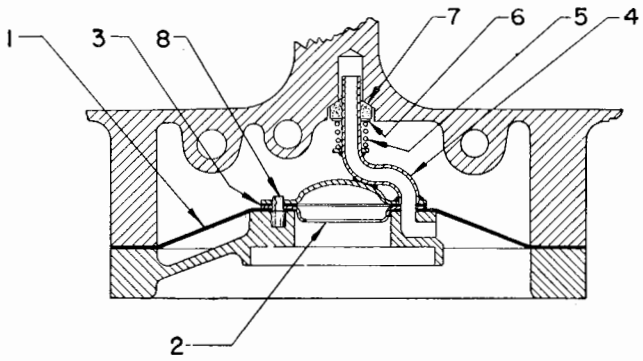
FIGURE 2 — USE OF T-25169 ASSEMBLY FIXTURE

(2) With the T-25169 fixture (2, figure 2) installed in the T-25303 assembly fixture (3), place the idle spring bushing assembly (1) in the fixture as shown in figure 2. Place the center body assembly over the bushing (1) and then install bushing (37, figure 5), gasket (38), large gasket (39), diaphragm plate (40), diaphragm assembly (41), plate (42), gasket (43), bushing (44) and paper gasket (45). Then place the constant effort spring (not shown in figure 5) on the plate (42). The raised portion of this plate will act as a spring guide for one end of the constant effort spring, and the retainer (11) will act as a guide for the other end of the spring.

(3) Assemble the front body assembly over the center body, alining the channels, and use care to avoid damaging the diaphragm (10) with the threaded end of the bushing (32). Be certain that the constant effort spring is alined with its guides as the two bodies are assembled together. Then install the bushing (46), washer (47), and castle nut (48). Be sure that the slots in the head of the bushing (32) are firmly engaged on the lugs of the special fixture, T-25169, so that the diaphragm will not twist when the nut (48) is tightened. Insert cotter pin (49). Then install only, the gasket (51), plate (52), gasket (53), and cover (54). On carburetors using a cover and tube assembly in place of the front cover (54) it will be necessary to install a front cover, locking nut plate and two gaskets, (parts 51 through 55) which have been modified to incorporate an alining pin hole, instead of the parts (1, through 7, figure 2A). These substitute parts are to be installed for test purposes only to prevent damage to the tube and the large gasket when the combined regulator and fuel control is installed on the flow bench fixture.

CAUTION

After completion of the flow bench test the substitute parts must be removed (only on regulators using the cover and tube assembly and the large gasket) and the correct parts installed, as described in paragraph d, 7, following.



1. Large Gasket
2. Locking Nut Plate
3. Small Gasket
4. Cover and Tube Assembly
5. Spring
6. Washer
7. Packing
8. Aligning Pin

FIGURE 2A — METHOD OF INSTALLING COVER AND TUBE ASSEMBLY

(4) Place the gasket (57) on over the spacer and shaft assembly (56), followed in turn by the diaphragm plate (58), fuel diaphragm assembly (59), plate (60), washer (61), and stem assembly (62). Hold the spacer and shaft assembly with special wrench T-25170 while tightening the hex portion of the stem assembly. Use a torque wrench to tighten this hex portion to 30-40 inch pounds. Lockwire this hex nut to the lug on the plate (60).

(5) Place the gasket (65) on center body, and install the fuel diaphragm assembly on the center body so that the guide portion of the stem enters the hollow portion of the guide bushing. (Items (63) and (64) not used on this model.)

(6) Attach the Regulator Unit rear body to the front and center bodies, using two small elastic stop nuts (87 and 89) and three large elastic stop nuts (81, 83 and 85), and their respective washers.

c Rear Body

(1) Place the poppet valve assembly (93) in the seat (92) and fasten the diaphragm shield (94) to the flange of the seat with three brass screws (95), prior to installing the complete valve and seat assembly in the Regulator Unit rear body.

(2) Install a new poppet valve packing (90) and gasket (91) in place in the rear body. Insert the poppet valve and seat assembly, screwing the stem back through the valve as this assembly slides into place. Use the T-25079 Allen wrench to turn the stem, and when the hexagonal (brass) end of the poppet valve can no longer be held firmly with the fingers (held to prevent twisting or tearing the diaphragm), hold the end of the valve with special socket T-25135, attaching the socket to the outer portion of special wrench T-25040. The Allen wrench will reach the poppet valve stem through the hollow stem of special wrench T-25040.

(3) When the stem is screwed back into the poppet valve far enough to bring the flange of the seat into contact with the Regulator Unit rear body, fasten the flange to the rear body, using the six fillister head screws (96). Tighten the screws down evenly. Do not lockwire at this time.

(4) Adjust the travel of the poppet valve to the preliminary setting given on the specification sheet for the carburetor being overhauled. This may be accomplished by screwing the poppet valve in or out with the Allen wrench (holding the valve itself from turning as described under Step (2), above) until the specified travel is obtained.

(5) Following the adjustment of the poppet valve, install the lockwasher and locknut (97) on the stem and tighten securely, holding the valve itself from turning as described under Step (2), above, and using the inner component of special wrench T-25040 to turn the poppet valve locknut.

NOTE

It is advisable to insert the T-25079 Allen wrench into the end of the stem, while the lock nut is being tightened. This will indicate whether or not the stem turns as the nut is being tightened. Any turning will change the poppet valve adjustment just obtained.

(6) All other parts of the Regulator Unit rear body, including the rear body cover can be assembled as shown in figure 5. However, it is recommended that the float stops on the two vapor vent float assemblies (98 and 115) be adjusted as directed in the Overhaul Manual.

(b) FUEL CONTROL UNIT—See Fig. 6.

1. The Fuel Control Unit can in general be disassembled and reassembled as outlined in the Overhaul Manual, and by referring to the exploded view shown in figure 6.

(c) THROTTLE UNIT—See Figure 7.

1. Disassembly

a Throttle Balance

(1) Disassemble the throttle balance by taking out the special screw (146) which holds it to the throttle body, and then removing the cotter pin (151), castle nut (150), and washer (149) from the throttle stop assembly (56). The assembly will now separate into the link assembly (143, 144, and 145), which attaches to the throttle body and is adjustable, the guide assembly (141) which attaches to the throttle arm, and the spring (142).

b Throttle Actuated Accelerating Pump

(1) Remove the cotter pins (157 and 162), castle nuts (156 and 161) and bolts (153 and 158) from link rod (152) between the pump lever (129) and the throttle lever (56).

(2) The removal of the pump assembly from the throttle body is acomplished by taking out the five hexagonal head bolts (135) from the flange of the pump cover (124). Carefully separate the pump cover (124) from the throttle body, then remove gasket (133). The cover contains the pump shaft and piston assembly (130) which is linked to the pump shaft (129).

(3) The cover assembly may be further disassembled by loosening the inside lever clamp screw and removing the taper set screw (132). Remove the packing nut (128) and take out the packing (125), washer (126), and spring (127).

c Boost Venturi Hanger

(1) The boost venturi hanger assembly (93) can be taken out by removing the four castle nuts (109) and washers (108) from studs (19) on center wall; then removing the cotter pins (104 and 107), nuts (103 and 106), and washers (102 and 105) from screws (100 and 101) which hold the brackets (97 and 99) in place at each end of throttle body. Remove the hanger assembly (93), brackets (97 and 99), and sealing rings (96 and 98). Do not attempt any further disassembly of the hanger assembly.

d Throttle Valves

(1) The four throttle valves (83) can be removed from the throttle body by removing four screws (85) from each, and sliding the valves out of their slots in the throttle shafts (44 and 65). Make certain to mark each valve so that it can be assembled in its same position in the throttle body.

NOTE

The left-hand and right-hand ends of the throttle shafts, as referred to in the following steps, are the left and right hand ends of these shafts when the throttle body is viewed from the rear. The rear of the throttle body is the surface to which the Regulator and Fuel Control Units attach.

e Throttle Shafts

(1) Remove the throttle shafts from the throttle body as follows: Remove the links (112 and 117) which connect the two throttle actuating levers at the left hand ends of the throttle shafts by removing the cotter pins (120), castle nuts (119) and bolts (110) which fasten these links to the levers. Care should be taken to avoid losing the small bushings (114) from the "eyes" of the levers. Note the number and position of the washers which are held in place by these bolts.

(2) Remove the cotter pin (82), castle nut (81) and flat washer (80) from the right-hand end of the front throttle shaft (65) and remove the latter from the throttle body as an assembly.

(3) To take out the rear throttle shaft assembly (44), remove the cotter pin (61), and castle nut (60), from the right-hand end of the shaft, and drive out the split taper pin (58) from the throttle lever and stop assembly (56). Remove the stop assembly and flat washer (55). Remove the throttle shaft as an assembly.

f Venturi Plates

(1) The removal of the venturi plates (23 and 34) may be accomplished by removing the twelve fillister-head screws from the sides of the throttle body, which hold the plates in place.

g Remove all plugs to facilitate cleaning the throttle body.

2. Assembly

a Throttle Shafts

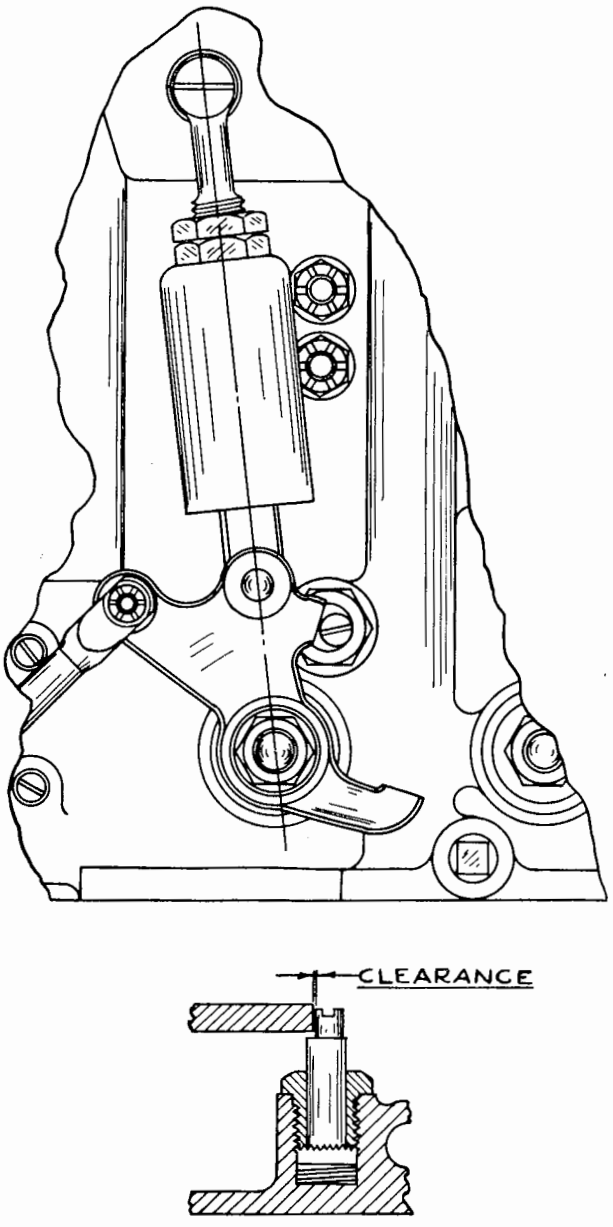
(1) Install new sealing rings (49 and 54) on rear throttle shaft assembly (44) and insert this assembly in the throttle body from left to right. If the throttle lever (62), castle nut (63) and cotter pin (64) were removed from the rear shaft, they can be reassembled at this time. Assemble the flat washer (55), throttle lever and stop assembly (56), spacer (59), and castle nut (60). Locate the lever so that the taper pin hole in the lever is aligned with the hole in the shaft. Drive a new No. 0 taper pin (58) in the assembly; tighten the castle nut (60) and install the cotter pin (61).

(2) However, if a new rear throttle shaft assembly (44) or throttle stop and lever assembly (56) is to be installed, proceed as follows:

(a) Install new sealing rings (49 and 54) on the throttle shaft assembly and insert the shaft assembly in the throttle body from left to right. Assemble the throttle valves, as outlined in step (5) following.

(b) Place the washer (55) on the right hand end of the throttle shaft, followed in turn by the throttle stop and lever assembly (56), and castle nut (60). Locate the lever radially, as shown in figure 3, and tighten the castle nut to hold the lever in this position while drilling and reaming the lever and shaft for a No. 0 taper pin. Install the taper pin and cotter pin (61).

(3) Install new sealing rings (67 and 79) on the front throttle shaft (65) and insert this shaft as an assembly, consisting of the flat washer (68), lever assembly (69), taper pin (73), castle nut (74), and cotter pin (75), in the throttle body from left to right. At the right hand end of the shaft, assemble the flat washer (80), castle nut (81) and cotter pin (82).



With the throttle valves completely closed, and the eccentric stops turned in the extreme position away from the levers, the clearance must be from .002 to .064 as shown. No. 29 (.136) drill and ream for No. 0 taper pin.

FIGURE 3 — ALIGNING THROTTLE STOP BEFORE DRILLING

(4) However, if a new front throttle shaft (65) or lever (69) is to be installed, proceed as follows:

(a) Put new sealing rings (67 and 79) on the throttle shaft and insert the shaft in the throttle body. At the right hand end of the shaft, assemble the flat washer (80), castle nut (81) and the cotter pin (82).

(b) After the throttle valves (83) have been installed, as directed in step (5) following, and with these valves in the fully closed position, assemble the lever (69) and castle nut (74). Adjust this lever radially so that the links (112 and 117), which connect the two throttle actuating levers, (69) on the front throttle shaft and (44) on the rear throttle shaft, can be assembled.

(c) When the foregoing adjustment has been made, tighten the castle nut (74) to hold the lever and shaft, and drill and ream for a No. 0 taper pin. Install the latter. The castle nut can then be tightened and cotter pinned.

(5) Assemble the four throttle valves (83) in the same position from which they were removed, using four new throttle valve screws (85) and washers (84) in each valve. The use of a feeler gage, which will insure a .002″-.004″ clearance at each end of each valve and a minimum of .005″ end play at each end of the shafts is recommended for this operation. Tighten the throttle valve screws securely and stake, as described in the Overhaul Manual.

(6) Assemble the links (112 and 117) which connect the two throttle actuating levers at the left hand end of the shafts, making certain that the small bushings (114) are in the "eyes" of the levers, and that the washers are in their correct position. Install the bolts, castle nuts and cotter pins.

b Venturi Plates

(1) Assemble the four venturi plates (23 and 34), using twelve fillister head screws and washers.

NOTE

Two of the twelve screws will fall within the circular area below the level of the Regulator Unit mounting flange. Be sure to install the two rubberized fiber washers (28 and 37) on these two screws and to lockwire the latter before assembling the Regulator Unit to the Throttle Unit.

c Boost Venturi Hanger

(1) Install the boost venturi hanger assembly (93), with its gasket (92) in place, by placing the ends of the hanger, with packing rings (96 and 98) attached, in the brackets (97 and 99). Install this assembly in the throttle body and fasten by using the four flat-head screws (100 and 101), washers (102 and 105), castle nuts (103 and 106), and cotter pins (104 and 107). Replace the four castle nuts (109) and washers (108).

d Throttle Balance

(1) Attach the throttle balance guide assembly, which includes the guide pin (145), the outside (adjustable) cover (143), and the cover lock nut (144) to the throttle body, using the special screw (146) and two washers (147 and 148).

(2) Place the throttle balance spring (142) in the link assembly (141); then insert the throttle balance link assembly in the guide assembly, making certain that the stem of the link assembly enters the hollow stem of the guide pin (145).

(3) Attach the "eye" of the link assembly to the throttle arm, and install the washer (149), castle nut (150), and cotter pin (151).

(4) Adjust the throttle balance by turning the outer cover (143) until a 4 to 4.5 pound load on the throttle lever will just start the throttle valves moving from the wide open position. Tighten and lockwire the throttle balance locknut (144) following this adjustment.

e Throttle Actuated Accelerating Pump

(1) Place the pump shaft packing nut (128), spring (127), washer (126), and packing (125) on the shaft assembly (129) and install the shaft in the cover (124). As the shaft is being inserted in the cover, the inside lever, which is part of the piston assembly (130), should be fitted over the shaft. Tighten the packing nut and then insert and tighten the taper set screw (132). Finally, tighten the clamp screw which is part of the piston assembly (130) and lockwire the set screw (132) and clamp screw together.

(2) It is assumed in the foregoing step that the same shaft and outside pump operating lever are being used. If a new assembly (129) is to be installed, it will be necessary to proceed as follows prior to placing the new shaft in the cover (124).

(a) Clamp the inside lever of the piston assembly (130) on the new shaft with the threaded taper set screw hole in the inside lever centered around the No. 42 hole already drilled in the new shaft. This threaded taper set screw hole should be on the same side of the shaft as the direction in which the outside pump operating lever projects. If the inside lever being installed was used on the old shaft, there will be a reamed hole in the far wall of the inside lever. Align this hole with the No. 42 hole drilled in the shaft; ream the latter for a No. 0000 taper set screw.

(b) However, if a new inside lever, which includes a new piston and link assembly (130), is being installed, there will not be a hole in the far wall of the inside lever. In this case, insert a No. 42 drill through the threaded hole in the inside lever and into the No. 42 hole drilled in the shaft; drill down through the far wall of the new inside lever prior to reaming the shaft and lever for a No. 0000 taper set screw. Finally, remove the inside lever from the shaft and proceed with the assembly of the cover assembly described above.

(3) Place the gasket (133) on the mounting flange of the pump cover assembly and install this assembly on the throttle body. The piston must be carefully fitted into the brass sleeve in the throttle body as the cover assembly is fitted to the throttle body. Fasten the cover to the throttle body using the five hex-head bolts (135) and washers (134). Lockwire the screws.

NOTE

Be certain that the check valve (122), gasket (121), and check valve (123), are installed before attaching the pump cover to the throttle body.

(4) Assemble the link (152) between the pump operating lever and the throttle lever and fasten in place with the bolts (153 and 158), washers (154 and 159), washers (155 and 160), castle nuts (156 and 161), and cotter pins (157 and 162). Install all plugs as shown in figure 7.

(d) ELECTRIC PRIMER VALVE—See Figure 8.

l. This Unit may be disassembled, overhauled and assembled as described in paragraph 4-84 of the Overhaul Manual.

(e) AUTOMATIC MIXTURE CONTROL UNIT—See Figure 9.

l. The disassembly, overhaul and assembly of the Automatic Mixture Control Unit can be accomplished by following the instructions given in Overhaul Manual and Aircraft Carburetor Service Bulletin No. 675.

3. Assemble the Fuel Control Unit to the Regulator Unit as described in the Stromberg Injection Carburetor Overhaul Manual and figure 4. However do not assemble these Units to the Throttle Unit until the following adjustments have been made.

d. ADJUSTMENT

1. Place the combined Fuel Control and Regulator Units on the combined T-25300 base and T-25290 head which comprise the test fixture and complete the flow bench test in accordance with the instruction in the Overhaul Manual, to ascertain whether the fuel flows at various metering suctions are within the limits specified for the particular carburetor setting. It may be necessary to readjust the poppet valve to bring these flows within the required limits.

NOTE

On regulators using a cover and tube assembly instead of the conventional front cover (54, figure 5) it is recommended that a conventional front cover be modified by drilling an alining pin hole, and this cover be used in place of the cover and tube assembly, as outlined in these instructions. After completion of the flow bench test these substitute parts must be removed and the correct parts installed before completely assembling the carburetor.

2. The poppet valve is adjusted as previously described under Assembly of the Regulator Unit included in these instructions. Turning the stem clockwise increases the travel and provides a richer setting; decreasing valve travel by turning the stem counter-clockwise, gives a leaner setting. Tighten the nut after each adjustment until proper setting is obtained. Replace the Regulator Unit rear body cover following each adjustment.

3. After the foregoing adjustment of these Units is attained, remove front body cover (54), figure 5, and install hold-down nut (50). Hold poppet valve on seat with the fingers, and turn hold-down nut down using special tool T-25168. The hold-down nut is to be turned clockwise **just to the point where,** when pushing on the front end of the diaphragm stem through the hole in the hold-down nut, **no play can be detected in the stem.** Then turn the hold-down nut counter-clockwise three-quarters to one an one-half turns. Install gasket (51), locking plate (52), gasket (53), cover (54) and six fillister head screws (55). Then remove two of the six screws which hold the poppet valve assembly in place in the rear body, install the poppet valve stop, replace the two screws and lockwire.

4. If the fuel metering head is not constant in the idle range (with the idle valve in the wide open position) the Regulator Unit must be disassembled and checked for correct springs or drag in the telescoping parts of the stem assembly.

5. If, after the flow bench test has been completed, the combined Regulator and Fuel Control Units are not flowing within the limits, it may be necessary to readjust the poppet valve to bring these flows within the required limits. However, if the adjustment of the poppet valve is changed, it will then be necessary to readjust the front stop in the Regulator front body as described in paragraph 3, of this section.

6. Check the enrichment valve setting as described in paragraph 5-23 of the Overhaul Manual.

7. After completion of the flow bench test, on carburetors **not incorporating** a cover and tube assembly in place of the front cover (54, figure 5) as outlined in figure 2A, tighten and lockwire the six fillister head screws (55) which secure the front cover to the regulator and then proceed to install the combined regulator and fuel control units or the throttle body unit as shown in figure 4. However, on carburetor models **incorporating** a cover and tube assembly in place of the front cover (54, figure 5) and as shown in figure 2A, proceed as follows:

(a) Remove the six fillister head screws (55, figure 5), the modified test cover (54), test gasket (53), the locking nut plate (52), and the test gasket (51). Exercise care when removing the locking nut plate (52) that the setting of the nut (50) is not disturbed. These removed parts were installed for use during the flow bench test only, in order to prevent damage to the large gasket and the cover and tube assembly (1 and 4 respectively, figure 2A) during the flow bench test.

(b) Now install the correct parts starting with the large gasket (1, figure 2A). Install this gasket on the regulator front body so that the holes in the gasket aline with the holes in the center portion of the front body and the alining pin (8) projects through the gasket.

(c) Install the correct locking nut plate (2) so that the alining pin hole in the plate alines with the pin (8). **Exercise caution when installing the locking nut plate** in order that the setting on the nut (50, figure 5) **is not disturbed** any more than is absolutely necessary to aline the serrations in the nut with those in the plate when the plate is alined with the pin (8). Then install the small gasket (3) making certain the holes in the gasket aline with the holes in the plate and that the alining pin (8) projects through the gasket.

(d) Install the cover and tube assembly (4) on the small gasket (3) so that the alining pin enters the alining pin hole in the cover and tube assembly. Then install the six fillister head screws (55, figure 5). Tighten and lockwire the screws.

(e) Install the spring (5, figure 2A) and the washer (6) and then install the packing (7) with the flat end against the washer (6).

NOTE

When installing the washer (6) it may be necessary to enlarge the inside diameter to permit free sliding along the tube; these parts must not bind.

(f) Assemble the combined regulator and fuel control units to the throttle body, making certain that the tube of the cover assembly is alined with the impact pressure channel in the throttle body. When fitting the large gasket (1, figure 2A) over the studs in the throttle body, exercise care that no damage to the gasket occurs.

8. Completely lockwire the assembled carburetor prior to installing the Unit on the engine.

e. PARTS LISTS AND EXPLODED VIEWS

A complete set of Parts Lists for the Stromberg PR-58E5 Injection Carburetor, listing all of the procurable parts, is incorporated herein and includes the folowing:

(a) Major Assembly Parts List (Complete Carburetor)
(b) Pressure Regulator Unit Assembly Parts Lists
(c) Fuel Control Unit Assembly Parts Lists
(d) Throttle Unit Assembly Parts Lists
(e) Automatic Mixture Control Unit Assembly Parts Lists
(f) Electric Primer Valve Assembly Parts List

Each Parts List is accompanied by an appropriate exploded view, with index numbers, illustrating component parts and their relationship to each other.

The **Major Assembly Parts List** gives the names and assembly numbers of the individual Units and the attaching parts required to assemble these Units into the complete carburetor.

The **Unit Assembly Parts Lists** give the names and part numbers of all parts required to assemble the individual Unit.

Variable parts, identified by "¢" in the "Nomenclature" column, include metering jets, bleeds, etc., the sizes of which may vary with individual carburetor settings although the part number will remain the same. Refer to the specification sheet for the correct sizes of variable parts.

Parts identified by an asterisk "*" in the "Nomenclature" column are special parts required for some particular setting. Refer to the specification sheet for the part numbers of these special parts.

When referring to a carburetor specification sheet be certain to select the specification sheet which has the same Parts List Number as appears on the specification plate attached to the carburetor throttle body. In general, it is recommended that the subject carburetor be reworked (if possible) to the latest Issue Number, the latter being stamped as a suffix to the Parts List Number. However, this recommendation may be amended by specific instructions included in service bulletins of Parts Lists Notes pertinent to the subject carburetor.

All carburetor parts listed in the Parts Lists can be purchased from Bendix Products Division, South Bend, Indiana and should be ordered by part number and name. When ordering parts, first refer to the proper specification sheet to determine if the part or parts required are special or variable parts, and if so, order the parts by the part number appearing on the specification sheet. If the required part or parts are not shown on the specification sheet, then refer to the parts list and exploded view for the part number. When ordering variable parts (metering jets, bleeds, etc.) be certain to give the correct size of the parts as well as the part number. Examples: P-22244-3100 cc metering jet or P-10455-42 metering jet. The ordering of Regulator Units, Fuel Control Units or Throttle Units as complete assemblies is not recommended.

PARTS LIST
AND
EXPLODED VIEWS

NOTE

The following Chart of Sub-Assemblies gives the parts list numbers of the component units in each of the carburetor Setting Parts Lists included in these instructions. This chart is a direct reference to the various Unit Parts Lists when used in conjunction with the PR-58E5 Assembly Parts List and Major Exploded View on the following page.

CHART OF SUB-ASSEMBLIES

SETTING PARTS LIST	REGULATOR UNIT	FUEL CONT. UNIT	THROTTLE BODY UNIT	AUTO. MIXT. CONTROL UNIT	ELECTRIC PRIM. UNIT	NOTES
390764	390756	395317	390755	395938	392434	
390765	390756	395317	390755	395938	392434	390764 plus 395814 P&W Spark Advance
390884	390756	395317	390755	390922	392434	
390885	390756	395317	390755	390922	392434	390884 plus 395814 P&W Spark Advance
390925	390756	395317	390755	395938	392434	390935 plus 395814 P&W Spark Advance
390935	390756	395317	390755	395938	392434	
390951	390756	395317	390966	395938	392434	390961 plus 395814 P&W Spark Advance
390961	390756	395317	390966	395938	392434	
390950	390756	395317	390966	390922	392434	390963 plus 395814 P&W Spark Advance
390963	390756	395317	390966	390922	392434	
390971	390756	395317	390755	390922	392434	390972 plus 395814 P&W Spark Advance
390972	390756	395317	390755	390922	392434	
390973	391035	395317	391036	391017	392434	390974 plus 395814 P&W Spark Advance
390974	391035	395317	391036	391017	392434	
391050	391035	395317	391036	391017	392434	
390962	390756	395317	390966	395938	392434	
390942	390756	395317	390966	395938	392434	390962 plus 395814 P&W Spark Advance

STROMBERG AIRCRAFT CARBURETOR SERVICE
Bendix Products Division
South Bend 20, Indiana
U. S. A.

BENDIX PRODUCTS DIVISION

OF BENDIX AVIATION CORPORATION

SOUTH BEND, INDIANA

PR-58E5 — Assembly Parts List

DATE: 12-15-49

Figure Number	Index Number	Bendix Part Number	Number Required	Nomenclature
4	1		ONE	*Regulator Assembly—No. 9 Pressure
4	2	P-70495	1	Gasket—Fuel control to regulator upper
4	3	393557	1	Gasket—Fuel control to regulator bottom
4	4		ONE	*Control Assembly—No. 9 Fuel
4	5	907239-K1	1	Washer—Regulator to fuel control body stud nut (AN960-416)
4	6	P-60244	1	Nut—Regulator to fuel control body stud (AN365D-428)
4	7	907239-K1	1	Washer—Regulator to fuel control body stud nut (AN960-416)
4	8	P-60244	1	Nut—Regulator to fuel control body stud (AN365D-428)
4	9	907239-K1	1	Washer—Fuel control body to regulator stud nut (AN960-416)
4	10	P-60244	1	Nut—Fuel control body to regulator stud (AN365D-428)
4	11	907239-K1	2	Washer—Fuel control body to regulator stud nut (AN960-416)
4	12	P-60244	2	Nut—Fuel control body to regulator stud (AN365D-428)
4	13	396621	1	Gasket—Regulator to throttle body NOTE: Used on all **except** Parts List 390973, 390974 and 391050.
4	13	363954	1	Gasket—Regulator to throttle body NOTE: Used on Parts List 390973, 390974 and 391050 **only.** NOTE: The following three parts (not illustrated) are used on Parts List 390973, 390974 and 391050 **only.**
4		P-61405	1	Packing—Impact channel (not illustrated)
4		362433	1	Spring—Impact channel (not illustrated)
4		P-22175	1	Washer—Impact channel (not illustrated)
4	14		ONE	*Body Assembly—Throttle
4	15	907239-K1	8	Washer—Regulator to throttle body stud nut (AN960-416)
4	16	P-60244	8	Nut—Regulator to throttle body stud (AN365D-428)
4	17	P-60541	1	Washer—Align brace spacer
4	18	399183	1	Brace—Throttle body to fuel control body (upper)
4	19	P-16708	2	Washer—Brace nut
4	20	P-70241	2	Nut—Brace (AN365D-524)
4	21	396519	1	Brace—Throttle body to fuel control body (lower)
4	22	P-16708	2	Washer—Brace nut
4	23	P-70241	2	Nut—Brace (AN365D-524)
4	24	396658	1	Link Assembly—Throttle to idle NOTE: Used on Parts List 390764, 390765, 390884, 390885, 390925, 390935, 390971 and 390972 **only.**
4		361668	1	Link—Idle (not illustrated) NOTE: Used on Parts List 390950, 390951, 390961, 390963, 391050, 390973, 390974 and 391011 **only.**
4	25	394421	1	Bushing—Throttle and idle control link
4	26	P-19820	1	Washer—Throttle and idle control link spring
4	27	394420	1	Washer—Throttle and idle control link
4	28	394420	1	Washer—Throttle and idle control link
4	29	394419	1	Bolt—Throttle and idle control link
4	30	394420	1	Washer—Throttle and idle control link
4	31	394420	1	Washer—Throttle and idle control link
4	32	P-20351	1	Nut—Throttle and idle control link bolt (AN320-3)
4	33	P-70565	1	Cotter Pin—Throttle and idle control link nut
4	34	394421	1	Bushing—Throttle and idle control link
4	35	P-19820	1	Washer—Throttle and idle control link spring
4	36	394420	1	Washer—Throttle and idle control link
4	37	394420	1	Washer—Throttle and idle control link
4	38	394419	1	Bolt—Throttle and idle control link
4	39	394420	1	Washer—Throttle and idle control link
4	40	394420	1	Washer—Throttle and idle control link
4	41	P-20351	1	Nut—Throttle and idle control link bolt (AN320-3)
4	42	P-70565	1	Cotter Pin—Throttle and idle control link nut
4		396966	1	Screen Assembly—Automatic mixture control (not illustrated)
4	43	394625	1	Gasket—Throttle body to automatic mixture control
4	44		1	¢Control Assembly—Automatic Mixture
4	45	907237-K1	3	Washer—Automatic mixture control (AN960-10)
4	46	P-13877	3	Nut—Automatic mixture control (AN310-3)
4	47	P-60150	2	Stud—Primer attaching (standard)
4	47	P-60150-1	AR	Stud—Primer attaching .003 in. OS on OD (first OS of P-60150)
4	47	P-60150-2	AR	Stud—Primer attaching .006 in. OS on OD (second OS of P-60150)
4	48	393655	1	Gasket—Primer valve
4	49		ONE	*Valve Assembly—Electric primer
4	50	907239-K1	2	Washer—Primer valve (AN960-416)
4	51	P-60244	2	Nut—Primer valve

A complete gasket set, including packings, can be obtained under Gasket Group Assembly 390797.

¢—Variable Parts, Refer to Specification Sheet for Size or to Chart of Sub-Assemblies for Part Number.
*—Special Parts, Refer to Specification Sheet or to Chart of Sub-Assemblies for Part Number.

AR—As Required.
OS—Oversize.
OD—Outside Diameter.

Parts List Number
390756
391035

BENDIX PRODUCTS DIVISION
OF BENDIX AVIATION CORPORATION
SOUTH BEND, INDIANA

PRESSURE REGULATOR UNIT — Assembly Parts List

DATE: (2-21-49) (2-21-49)

Figure Number	Index Number	Bendix Part Number	Number Required Per Unit 390756	Number Required Per Unit 391035	Nomenclature
					FRONT BODY PARTS
5	1	396553	1	NU	Body Assembly—Front
5	1	362437	NU	1	Body Assembly—Front
5	2	P-70062	2	2	Stud—Front body (standard)
5	2	P-70062-1	AR	AR	Stud—Front body .003 in. OS on OD (first OS of P-70062)
5	2	P-70062-2	AR	AR	Stud—Front body .006 in. OS on OD (second OS of P-70062)
5		362436	NU	1	Pin—Locating (not illustrated)
5	3	P-9201	1	1	¢Bleed—Lower pump restriction
5	4	P-19623	1	1	¢Bleed—Inside mixture control
5	5	P-9201	1	1	¢Bleed—Upper pump restriction
5	6	393399	1	1	Plug—5/16-24 taper seat
5	7		NU	NU	Not Used
5	8	392829	1	1	Gasket—Guide plate
5	9	396690	1	1	Plate—Guide
5	10	394354	1	1	Diaphragm—Sealing
5	11	361625	1	1	Plate—Front diaphragm retainer
5	12		NU	NU	Not Used
5		361618	6	6	Lockwasher—Retaining plate screw (not illustrated)
5	13	361619	6	6	Screw—Retaining plate
					CENTER BODY PARTS
5	14	398447	1	1	Body Assembly—Center
5	15	P-20506	1	1	Stud—Center body (standard)
5	15	P-20506-1	AR	AR	Stud—Center body .003 in. OS on OD (first OS of P-20506)
5	15	P-20506-2	AR	AR	Stud—Center body .006 in. OS on OD (second OS of P-20506)
5	16	397250	1	1	Stud—Center body (standard)
5	16	397251	AR	AR	Stud—Center body .003 in. OS on OD (first OS of 397250)
5	16	397252	AR	AR	Stud—Center body .006 in. OS on OD (second OS of 397250)
5	17	360610	2	2	Stud—Center body (standard)
5	17	360611	AR	AR	Stud—Center body .003 in. OS on OD (first OS of 360610)
5	17	360612	AR	AR	Stud—Center body .006 in. OS on OD (second OS of 360610)
5	18	392502	1	1	¢Bleed—Outside mixture control
5	19	393399	1	1	Plug—5/16-24 taper seat
5	20	P-8508	2	2	Plug—⅛-inch pipe (AN913-1)
5	21	P-8508	1	1	Plug—⅛-inch pipe (AN913-1)
5	22	393399	1	1	Plug—5/16-24 taper seat
5	23	397116	1	1	Gasket—Spark advance cover
5	24	394657	1	1	Cover—Spark advance
5	25	397171	2	2	Washer—Spark advance cover nut
5	26	397151	2	2	Nut—Spark advance cover
5	27	392739	2	2	Cotter Pin—Spark advance cover nut
5	28	396719	1	1	Diaphragm—Sealing
5	29	392829	1	1	Gasket—Guide
5	30	396706	1	1	Plate—Diaphragm
5	31	361609	6	6	Screw—Diaphragm plate
5	32	396700	1	1	Bushing—Poppet valve shaft
5	33	399154	1	1	Spring—Poppet valve shaft
5	34	396689	1	1	Bushing—Spring guide
5	35	396699	1	1	Guide—Spacer and shaft
5	36	396698	1	1	Ring—Spacer and guide snap
5	37	396707	1	1	Bushing—Diaphragm spacer
5	38	P-70042	1	1	Gasket—Guide bushing
5	39	396551	1	1	Gasket—Front and center body
5	40	P-70005	1	1	Plate—Diaphragm
5	41	399309	1	1	Diaphragm Assembly—Front
5	42	361052	1	1	Plate—Diaphragm
5		361049	1	1	Spring—Constant effort (not illustrated)
5	43	P-70042	1	1	Gasket—Diaphragm plate
5	44	P-70309	1	1	Bushing—Guide
5	45	396551	1	1	Gasket—Front to center body
5	46	P-70307	1	1	Bushing—Guide
5	47	907239-K1	1	1	Washer—Poppet valve shaft bushing nut (AN960-416)
5	48	P-6867	1	1	Nut—Poppet valve shaft bushing (AN310-4)
5	49	P-70565	1	1	Cotter Pin—Poppet valve shaft bushing nut
5	50	396702	1	1	Nut—Spring, hold down
5	51	P-70027	1	NU	Gasket—Locking nut plate
5		362417	NU	1	Gasket—Front body to throttle body
5	52	396701	1	NU	Plate—Locking nut
5	52	362429	NU	1	Plate—Locking nut
5	53	P-70027	1	NU	Gasket—Front cover
5	53	362430	NU	1	Gasket—Front cover
5	54	P-70013	1	NU	Cover—Front
5	54	362418	NU	1	Cover and Tube Assembly—Front (not illustrated)
5	55	398755	6	6	Screw—Front cover
5	56	396705	1	1	Spacer and Shaft Assembly—Poppet valve
5	57	P-70042	1	1	Gasket—Diaphragm plate
5	58	P-70005	1	1	Plate—Diaphragm
5	59	399311	1	1	Diaphragm Assembly—Rear
5	60	397455	1	1	Plate and Pin Assembly—Diaphragm
5	61	396716	1	1	Washer—Poppet valve adjustment screw
5	62	363288	1	1	Screw Assembly—Poppet valve adjustment
5	63		NU	NU	Not Used
5	64		NU	NU	Not Used
5	65	396550	1	1	Gasket—Rear and center body
5	66	396550	1	1	Gasket—Rear and center body
					REAR BODY PARTS
5	67	396959	1	1	Body Assembly—Rear
5	68	P-70006	1	1	Bushing—Strainer bolt (standard)
5	68	P-70006-1	AR	AR	Bushing—Strainer bolt .002 in. OS on OD (first OS of P-70006)
5	69	P-17623	2	2	Pin—Strainer bolt bushing
5	70	P-70055	1	1	Reducer—Rear body (standard)
5	70	398021	AR	AR	Reducer—Rear body .006 in. OS on OD (first OS of P-70055)
5	71	P-70055	1	1	Reducer—Rear body (standard)
5	71	398021	AR	AR	Reducer—Rear body .006 in. OS on OD (first OS of P-70055)
5	72	P-70056	1	1	Bushing—Fulcrum screw (standard)
5	72	P-70056-1	AR	AR	Bushing—Fulcrum screw .003 in. OS on OD (first OS of P-70056)
5	73	P-20109	1	1	Bushing—Rear body
5	74	P-20109	1	1	Bushing—Rear body
5	75	392830	10	10	Stud—Rear body to cover (standard)
5	75	392831	AR	AR	Stud—Rear body to cover .003 in. OS on OD (first OS of 392830)
5	75	392832	AR	AR	Stud—Rear body to cover .006 in. OS on OD (second OS of 392830)
5	76	392880	1	1	Stud—Rear to center body (standard)
5	76	392881	AR	AR	Stud—Rear to center body .003 in. OS on OD (first OS of 392880)
5	76	392882	AR	AR	Stud—Rear to center body .006 in. OS on OD (second OS of 392880)
5	77	P-60463	2	2	Stud—Rear to center body (standard)
5	77	P-60463-1	AR	AR	Stud—Rear to center body .003 in. OS on OD (first OS of P-60463)
5	77	P-60463-2	AR	AR	Stud—Rear to center body .006 in. OS on OD (second OS of P-60463)
5	78	394422	1	1	Baffle—Poppet valve
5	79	393726	3	3	Screw—Poppet valve baffle
5	80	907239-K1	1	1	Washer—Rear to center body stud attaching nut (AN960-416)
5	81	P-60244	1	1	Nut—Rear to center body stud attaching (AN365-D-428)
5	82	907239-K1	1	1	Washer—Rear to center body stud attaching nut (AN960-416)
5	83	P-60244	1	1	Nut—Rear to center body stud attaching (AN365-D-428)
5	84	907239-K1	1	1	Washer—Rear to center body stud attaching nut (AN960-416)
5	85	P-60244	1	1	Nut—Rear to center body stud attaching (AN365-D-428)
5	86	907237-K1	1	1	Washer—Front to center body stud nut (AN960-10)
5	87	P-60303	1	1	Nut—Front to center body stud (AN365-D-1032)
5	88	907237-K1	1	1	Washer—Front to center body stud nut (AN960-10)
5	89	P-60303	1	1	Nut—Front to center body stud (AN365-D-1032)
5	90	393535	1	1	Packing—Poppet valve seat
5	91	393531	1	1	Gasket—Poppet valve seat
5	92	397947	1	1	Seat—Poppet valve
5	93	360678	1	1	Valve and Diaphragm Assembly—Poppet
5	94	360675	1	1	Shield—Poppet valve diaphragm
5	95	P-13140	3	3	Screw—Poppet valve seat to shield
5	96	392684	6	6	Screw—Poppet valve and seat
5		360680	1	1	Lockwasher—Poppet valve stem nut (not illustrated)
5		360681	1	1	Stop—Poppet valve (not illustrated)
5	97	394955	1	1	Nut—Poppet valve lock
5	98	399184	1	1	Float Assembly—Right
5	99	P-70054	1	1	Valve—Float needle
5	100	399983	1	1	Gasket—Fulcrum screw
5	101	P-70057	1	1	Screw Assembly—Fulcrum
5	102	393585	1	1	Gasket—Float seat
5	103	399999	1	1	Gasket—Float seat
5	104	393536	1	1	Seat—Float needle valve
5	105	393541	1	1	Bolt—Strainer
5	106	174-8-4	1	1	Gasket—Strainer bolt
5	107	394703	1	1	Cover—Strainer
5	108	393540	1	1	Spring—Strainer
5	109	393520	1	1	Strainer Assembly—Fuel
5		901201-K1	1	1	Cotter Pin—Strainer bolt (not illustrated)
5	110	P-70039	1	1	Gasket—Strainer cover
5	111	393544	1	1	Gasket—Rear body to cover
5	112	397164	1	1	Cover Assembly—Rear
5	113	P-70056	1	1	Bushing—Fulcrum screw (standard)
5	113	P-70056-1	AR	AR	Bushing—Fulcrum screw .003 in. OS on OD (first OS of P-70056)
5	114	360710	3	3	Stud—Rear cover (standard)
5	114	360711	AR	AR	Stud—Rear cover .0026 in. OS on OD (first OS of 360710)
5	114	360712	AR	AR	Stud—Rear cover .0052 in. OS on OD (second OS of 360710)
5	115	399253	1	1	Float Assembly—Left
5	116	P-70054	1	1	Valve—Float needle
5	117	399983	1	1	Gasket—Fulcrum screw
5	118	P-70057	1	1	Screw Assembly—Fulcrum
5	119	393585	1	1	Gasket—Float seat
5	120	399999	1	1	Gasket—Float seat
5	121	397989	1	1	Seat—Float needle valve
5		P-8508	1	1	Plug—⅛-inch pipe (AN913-1) (not illustrated)
5	122	907237-K1	10	10	Washer—Rear cover attaching nut (AN960-10)
5	123	P-60303	10	10	Nut—Rear cover attaching (AN365-D-1032)
5	124	393647	NU	NU	Not Used
5	125	393647	1	1	Plug—10-32 taper seat
5	126	394759	1	1	Reducer—Unmetered fuel vent float restriction
5	127	397296	1	1	Plug—5/16-24 taper seat
5	128	393646	1	1	Plug—8-32 taper seat
5	129	P-8508	1	1	Plug—⅛-inch pipe (AN913-1)
5	130	P-8508	1	1	Plug—⅛-inch pipe (AN913-1)
5	131	P-8508	1	1	Plug—⅛-inch pipe (AN913-1)
5	132	P-8508	1	1	Plug—⅛-inch pipe (AN913-1)
5	133	P-70000	1	1	Plate—Specification
5	134	P-16630	2	2	Screw—Specification plate drive (AN535-0-3)
5		P-60961	2	2	Seal—Lockwiring lead (not illustrated)

¢—Variable Parts, Refer to Specification Sheet for Size.
*—Special Parts, Refer to Specification Sheet for Part Number.
AR—As Required.
OS—Oversize.
OD—Outside Diameter.
NU—Not Used

¢—Variable Parts, Refer to Specification Sheet for Size.
*—Special Parts, Refer to Specification Sheet for Part Number.
AR—As Required
OS—Oversize.
OD—Outside Diameter.
NU—Not Used

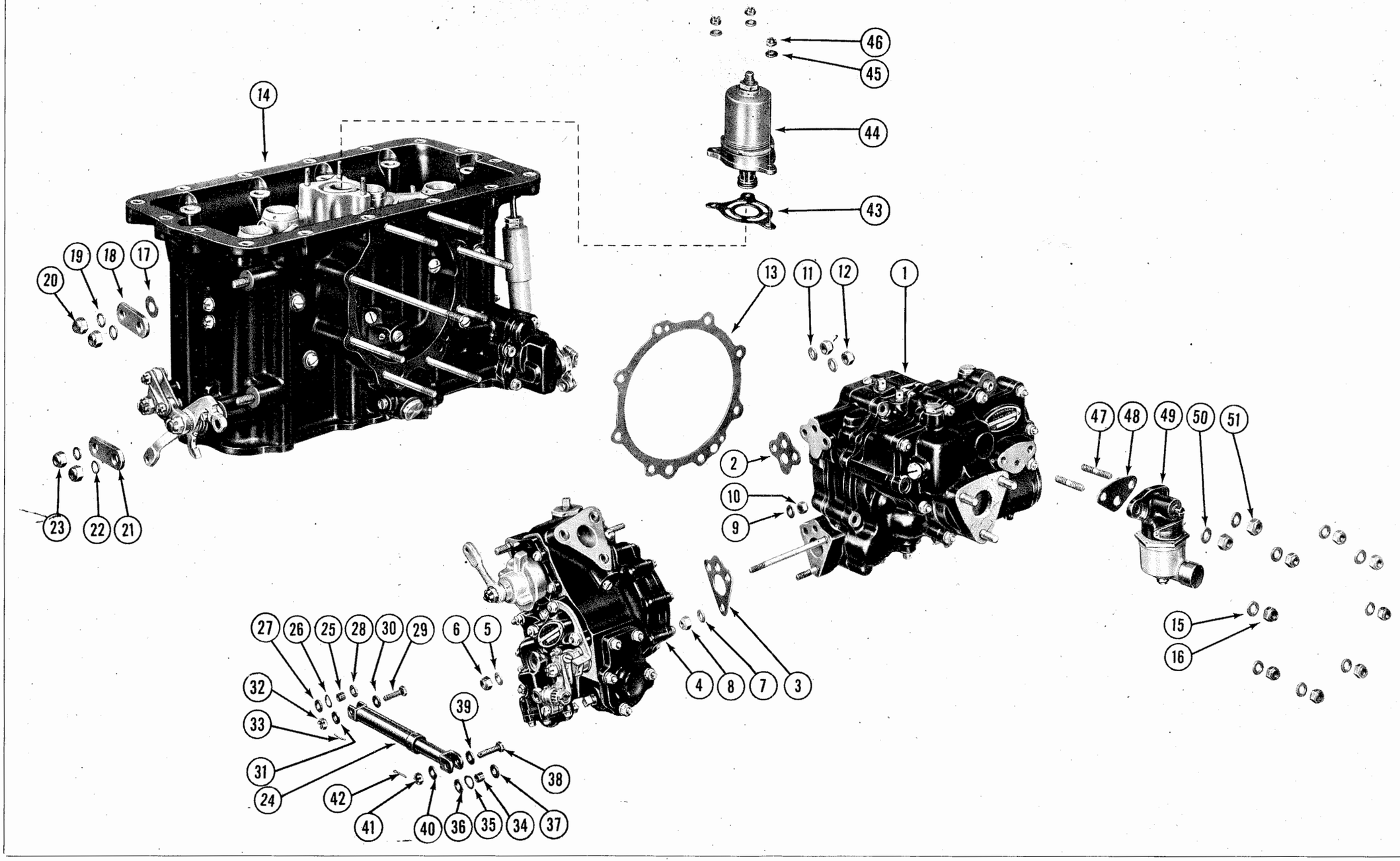


FIGURE 4
MAJOR VIEW

Parts List Number

395317

BENDIX PRODUCTS DIVISION
OF BENDIX AVIATION CORPORATION
SOUTH BEND, INDIANA

FUEL CONTROL UNIT — Assembly Parts List

DATE: (10-13-47) (10-13-47)

Figure Number	Index Number	Bendix Part Number	Number Required	Nomenclature
6	1	397270	1	Body Assembly—Fuel control
6	2	P-70385	3	Bushing—Outlet flange (standard)
6	2	P-70385-1	AR	Bushing—Outlet flange .003 in. OS on OD (first OS of P-70385)
6	2	P-70385-2	AR	Bushing—Outlet flange .007 in. OS on OD (second OS of P-70385)
6	3	383850	1	Bushing—Idle shaft (standard)
6	3	383851	AR	Bushing—Idle shaft .003 in. OS on OD (first OS of 383850)
6		398535	1	Packing—Idle shaft bushing (not illustrated)
6	4	394228	1	Bushing—Idle shaft
6	5	397469	2	Pin—Idle shaft bushing
6	6	P-70179	1	Bushing—Mixture control valve stem (standard)
6	6	P-70179-1	AR	Bushing—Mixture control valve stem .003 in. OS on OD (first OS of P-70179)
6	7	P-20506	3	Stud—Fuel control to regulator (standard)
6	7	P-20506-1	AR	Stud—Fuel control to regulator .003 in. OS on OD (first OS of P-20506)
6	7	P-20506-2	AR	Stud—Fuel control to regulator .006 in. OS on OD (second OS of P-20506)
6	8	392830	5	Stud—Idle valve cover (standard)
6	8	392831	AR	Stud—Idle valve cover .003 in. OS on OD (first OS of 392830)
6	8	392832	AR	Stud—Idle valve cover .006 in. OS on OD (second OS of 392830)
6	9	P-70604	3	Stud—Jet cover (standard)
6	9	P-70604-1	AR	Stud—Jet cover .003 in. OS on OD (first OS of P-70604)
6	9	P-70604-2	AR	Stud—Jet cover .006 in. OS on OD (second OS of P-70604)
6	10	398760	1	Stud—Jet cover (standard)
6	10	398761	AR	Stud—Jet cover .003 in. OS on OD (first OS of 398760)
6	10	398762	AR	Stud—Jet cover .006 in. OS on OD (second OS of 398760)
6	11	P-10791	1	Stud—Brace (standard)
6	11	P-70191-1	AR	Stud—Brace .003 in. OS on OD (first OS of P-70191)
6	11	P-70191-2	AR	Stud—Brace .006 in. OS on OD (second OS of P-70191)
6	12	392830	2	Stud—Jet cover (standard)
6	12	392831	AR	Stud—Jet cover .003 in. OS on OD (first OS of 392830)
6	12	392832	AR	Stud—Jet cover .006 in. OS on OD (second OS of 392830)
6	13	398760	1	Stud—Jet cover (standard)
6	13	398761	AR	Stud—Jet cover .003 in. OS on OD (first OS of 398760)
6	13	398762	AR	Stud—Jet cover .006 in. OS on OD (second OS of 398760)
6	14	P-70191	1	Stud—Brace (standard)
6	14	P-70191-1	AR	Stud—Brace .003 in. OS on OD (first OS of P-70191)
6	14	P-70191-2	AR	Stud—Brace .006 in. OS on OD (second OS of P-70191)
6	15	397240	1	Stud—Jet cover (standard)
6	15	397241	AR	Stud—Jet cover .003 in. OS on OD (first OS of 397240)
6	15	397242	AR	Stud—Jet cover .006 in. OS on OD (second OS of 397240)
6	16	393577	1	Gasket—Lower mixture control valve plate
6	17	397318	1	Plate—Lower mixture control valve
6	18	P-70728	4	Screw—Mixture control valve plate
6	19	P-70582	1	Valve Assembly—Fill
6	20	398975	1	Gasket—Fill valve plug
6	21	393526	1	Plug—Fill valve
				MANUAL CONTROL SELECTOR SYSTEM
6	22	360429	1	Plate—Upper mixture control valve
6	23	P-70941	1	Gasket—Mixture control valve plate
6	24	398778	1	Stem—Mixture control valve cam
6	25	P-70598	1	Spring—Mixture control valve cam stem
6	26	P-70593	1	Gasket—Mixture control cover
6	27	394061	1	Latch and Stem Assembly—Mixture control
6	28	397435	1	Stem—Mixture control
6	29	P-70641	1	Washer—Mixture control stem
6	30	393349	1	Bushing—Mixture control stem
6	31	393348	1	Washer—Mixture control packing
6	32	P-70597	1	Spring—Mixture control packing
6	33	P-70525	1	Washer—Mixture control packing
6	34	P-70490	1	Packing—Mixture control
6	35	P-70592	1	Cover Assembly—Mixture control
6	36	P-61144	2	Pin—Cover (standard)
6	36	P-61144-1	AR	Pin—Cover .002 in. OS on OD (first OS of P-61144)
6	36	P-61144-2	AR	Pin—Cover .004 in. OS on OD (second OS of P-61144)
6	37	P-70514	1	Packing—Mixture control cover
6	38	394065	1	Plate—Lower mixture control latch
6	39	394064	1	Plate—Upper mixture control latch
6	40	P-70528	1	Spring—Mixture control latch plate
6	41	394062	1	Cover Assembly—Mixture control latch
6	42	P-70536	2	Pin—Cover (standard)
6	42	P-70536-1	AR	Pin—Cover .002 in. OS on OD (first OS of P-70536)
6	42	P-70536-2	AR	Pin—Cover .004 in. OS on OD (second OS of P-70536)
6	43	P-19086	1	Taper Pin—Mixture control cover (standard)
6	43	P-19086-1	AR	Taper Pin—Mixture control cover .005 in. OS on OD (first OS of P-19086)
6	44	P-15350	6	Washer—Mixture control cover screw
6	45	P-13618	6	Screw—Mixture control cover (AN500A10-10)
6	46	P-22136	1	Lever—Mixture control
6	47	900848-K1	1	Nut—Mixture control lever (AN310-5)
				IDLE SYSTEM
6	48	P-70565	1	Cotter Pin—Mixture control lever nut
6	49		1	*Valve Assembly—Idle
6	50	393524	1	Packing—Idle valve sleeve
6	51	394944	2	Washer—Idle valve sleeve
6	52	P-21818	2	Screw—Idle valve sleeve
6	53	399544	1	Lever and Stem Assembly—Idle adjustment
6	54	393035	1	Stem—Idle
6	55	P-70686	1	Screw Assembly—Idle lever
6	56	P-21267	1	Pin—Idle lever and stem (standard)
6	56	P-21267-1	AR	Pin—Idle lever and stem .005 in. OS on OD (first OS of P-21267)
6	57	399545	1	Spring—Idle adjustment
6	58	P-6588	1	Screw—Idle adjustment spring
6		399543	1	Bolt—Idle adjustment spring holding (not illustrated)

¢—Variable Parts, Refer to Specification Sheet for Size. OS—Oversize.
*—Special Parts, Refer to Specification Sheet for Part Number. OD—Outside Diameter.
AR—As Required.

Figure Number	Index Number	Bendix Part Number	Number Required	Nomenclature
6		P-16014	1	Nut—Idle adjustment spring holding bolt (not illustrated)
6		393363	1	Cotter Pin—Idle adjustment spring holding bolt nut (not illustrated)
6	59	901004	1	Lockwasher—Idle valve screw (AN935-10)
6	60	P-70629	1	Screw—Idle lever
6	61	907239-K1	1	Washer—Idle adjustment lever nut (AN960-416)
6	62	P-6867	1	Nut—Idle adjustment lever (AN310-4)
6	63	P-70565	1	Cotter Pin—Idle adjustment lever nut
6	64	394229	1	Nut—Idle stem packing
6	65	394226	1	Spring—Idle stem packing
6	66	394227	1	Washer—Idle stem packing
6	67	390293	1	Packing—Idle stem
6	68	P-70186	1	Lever Assembly—Inside idle
6	69	P-22198	1	Washer—Idle lever screw
6	70	P-21818	1	Screw—Idle lever
6	71	P-70150	1	Pin—Idle lever taper set screw
6	72	P-9201	1	¢Bleed—Idle chamber vent restriction
6	73	397645	1	Spring and Plate Assembly—Idle valve
6	74	P-70603	1	Gasket—Idle valve cover
6	75	P-70599	1	Cover—Idle valve
6	76	907237-K1	5	Washer—Idle valve cover nut (AN960-10)
6	77	P-60303	5	Nut—Idle valve cover (AN365-D-1032)
				ENRICHMENT VALVE SYSTEM
6	78	P-9201	1	¢Bleed—Enrichment valve vent restriction
6	79	P-70481	1	Bushing—Diaphragm
6	80	398879	1	Gasket—Diaphragm
6	81	P-70478	1	Plate—Diaphragm
6	82	399176	1	Shield and Diaphragm Assembly—Enrichment valve
6	83	P-70480	1	Plate—Diaphragm
6	84	P-2885	1	Gasket—Diaphragm plate
6	85	P-70491	1	Nut—Diaphragm bushing (AN320-6)
6	86	P-70565	1	Cotter Pin—Diaphragm bushing nut
6	87	393562	1	Gasket—Enrichment valve diaphragm
6	88	P-70472	1	Cover—Enrichment valve diaphragm
6	89	P-15350	8	Washer—Enrichment valve diaphragm cover screw
6	90	P-13618	8	Screw—Enrichment valve diaphragm cover
6	91	P-10455	1	¢Jet—Automatic rich metering
6	92	P-22244	1	¢Jet—Automatic lean metering
6	93	P-22244	1	¢Jet—Power enrichment metering
6	94		1	*Valve—Enrichment
6	95	362304	1	Seat—Enrichment valve
6	96		1	*Spring—Enrichment valve
6	97	392705	1	Nut—Enrichment valve spring
6	98	P-70065	1	Nut—Enrichment valve
6	99	P-5439	1	Gasket—Enrichment valve seat
6	100	P-70563	1	Screw—Enrichment valve seat lockwiring
6	101	397500	1	Valve Assembly—Derichment
6	102	397278	1	Body Assembly—Jet cover and derichment valve
6	103	397294	1	Spring—Derichment valve
6	104	397289	1	Retainer—Derichment valve spring
6	105	397288	1	Valve—Derichment
6	106	397284	1	Diaphragm Assembly—Derichment valve
6	107	398899	1	Plug—Derichment valve seat
6		P-8508	1	Plug—⅛-inch pipe (AN913-1) (not illustrated)
6	108	361115	1	Cover—Derichment valve
6	109	P-15350	4	Washer—Derichment valve cover screw
6	110	P-13618	4	Screw—Derichment valve (AN503-10-10)
6	111	P-22244	1	¢Jet—Derichment metering
6	112	393625	1	Gasket—Jet cover
6	113	399273	1	*Stop—Idle adjustment
				NOTE: Subject to special part number—See specification sheet.
6	114	907237-K1	6	Washer—Jet cover nut (AN960-10)
6	115	P-60303	8	Nut—Jet cover (AN365-D-1032)
6	116	P-61195	1	Plug—¼-28 taper seat
6	117	392502	1	¢Bleed—Unmetered fuel vent restriction
6	118	392502	1	¢Bleed—Metered fuel vent restriction
6	119	393399	1	Plug—5/16-24 taper seat
6	120	P-9201	1	¢Bleed—Enrichment valve delay restriction
6	121	393399	1	Plug—5/16-24 taper seat
6	122	P-61195	1	Plug—¼-28 taper seat
6	123	393644	1	Plug—7/16-20 taper seat
6	124	P-8508	1	Plug—⅛-inch pipe (AN913-1)
6	125	P-8508	1	Plug—⅛-inch pipe (AN913-1)
6	126	P-70000	1	Plate—Specification
6	127	P-16630	2	Screw—Specification plate drive (AN535-0-3)

¢—Variable Parts, Refer to Specification Sheet for Size. OS—Oversize.
*—Special Parts, Refer to Specification Sheet for Part Number. OD—Outside Diameter.
AR—As Required.

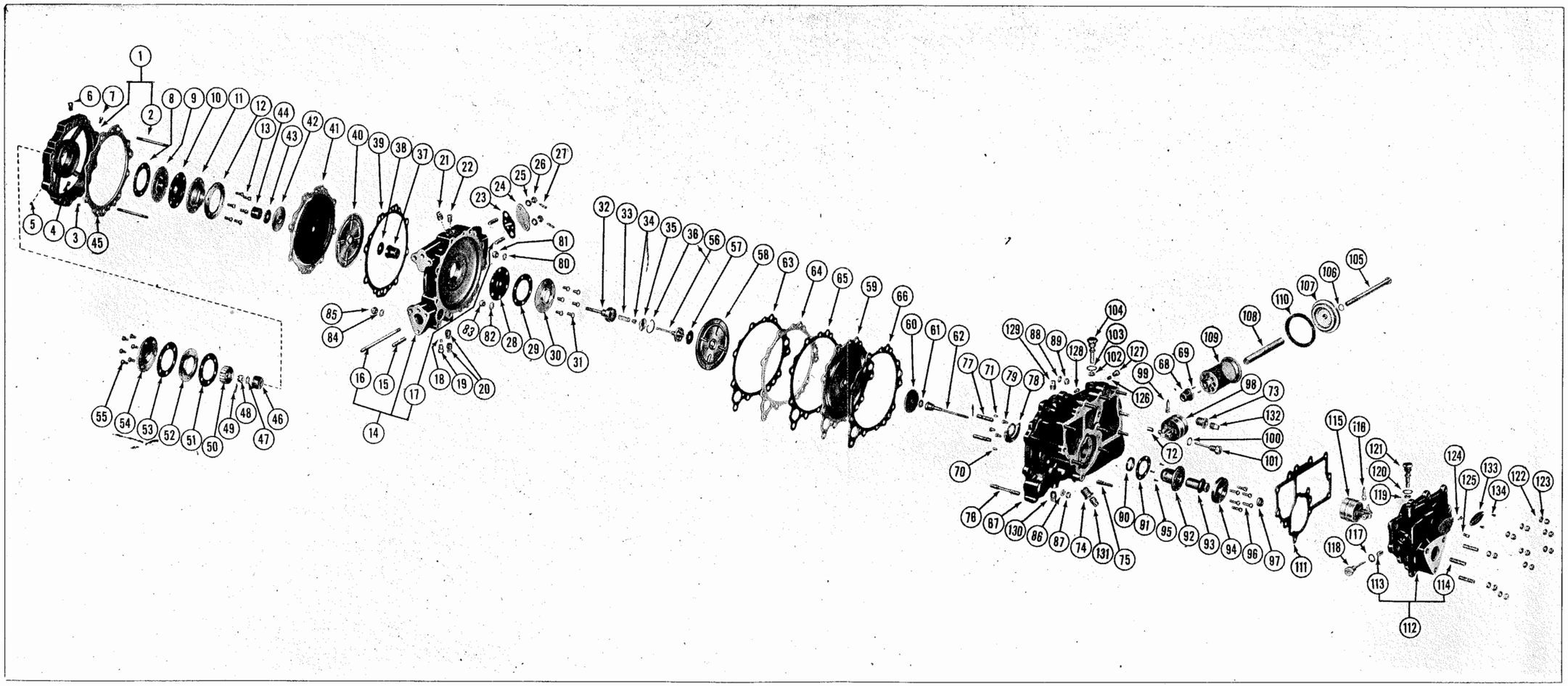


FIGURE 5
PRESSURE REGULATOR UNIT

Parts List Number
390755, 390966
391036

BENDIX PRODUCTS DIVISION
OF BENDIX AVIATION CORPORATION
SOUTH BEND, INDIANA

THROTTLE BODY UNIT — Assembly Parts List

DATE: (1-14-49) (2-21-49) (1-14-49)

Figure Number	Index Number	Bendix Part Number	Number Required Per Unit			Nomenclature
			390755	390966	391036	
7	1	361053	1	1	NU	Body Assembly—Throttle
7	1	362438	NU	NU	1	Body Assembly—Throttle
7	2	393754	1	1	1	Bearing—Throttle body needle
7	3	393754	1	1	1	Bearing—Throttle body needle
7	4	393754	2	2	2	Bearing—Throttle body needle
7	5	393754	2	2	2	Bearing—Throttle body needle
7	6	394450	2	2	2	Bushing—Throttle shaft needle bearing retainer (standard)
7	6	394451	AR	AR	AR	Bushing—Throttle shaft needle bearing retainer .005 in. OS on OD (first OS of 394450)
7	6	394452	AR	AR	AR	Bushing—Throttle shaft needle bearing retainer .010 in. OS on OD (second OS of 394450)
7	7	394450	1	1	1	Bushing—Throttle shaft needle bearing retainer (standard)
7	7	394451	AR	AR	AR	Bushing—Throttle shaft needle bearing retainer .005 in. OS on OD (first OS of 394450)
7	7	394452	AR	AR	AR	Bushing—Throttle shaft needle bearing retainer .010 in. OS on OD (second OS of 394450)
7	8	394450	1	1	1	Bushing—Throttle shaft needle bearing retainer (standard)
7	8	394451	AR	AR	AR	Bushing—Throttle shaft needle bearing retainer .005 in. OS on OD (first OS of 394450)
7	8	394452	AR	AR	AR	Bushing—Throttle shaft needle bearing retainer .010 in. OS on OD (second OS of 394450)
7	9	396527	1	1	1	Sleeve—Accelerating pump
7	10	P-70250	10	10	10	Bushing—Throttle body (standard)
7	10	P-70250-1	AR	AR	AR	Bushing—Throttle body .003 in. OS on OD (first OS of P-70250)
7	11	393270	16	16	16	Bushing—Air intake flange (standard)
7	11	393271	AR	AR	AR	Bushing—Air intake flange .0015 in. OS on OD (first OS of 393270)
7	11	393272	AR	AR	AR	Bushing—Air intake flange .0030 in. OS on OD (second OS of 393270)
7	12	397469	32	32	32	Pin—Air intake bushing
7	13	392870	3	3	3	Stud—Regulator attaching (standard)
7	13	392871	AR	AR	AR	Stud—Regulator attaching .002 in. OS on OD (first OS of 392870)
7	13	392872	AR	AR	AR	Stud—Regulator attaching .004 in. OS on OD (second OS of 392870)
7	14	392870	3	3	3	Stud—Regulator attaching (standard)
7	14	392871	AR	AR	AR	Stud—Regulator attaching .002 in. OS on OD (first OS of 392870)
7	14	392872	AR	AR	AR	Stud—Regulator attaching .004 in. OS on OD (second OS of 392870)
7	15	393060	1	1	1	Stud—Regulator attaching (standard)
7	15	393061	AR	AR	AR	Stud—Regulator attaching .002 in. OS on OD (first OS of 393060)
7	15	393062	AR	AR	AR	Stud—Regulator attaching .004 in. OS on OD (second OS of 393060)
7	16	394260	1	1	1	Stud—Regulator attaching (standard)
7	16	394261	AR	AR	AR	Stud—Regulator attaching .002 in. OS on OD (first OS of 394260)
7	16	394262	AR	AR	AR	Stud—Regulator attaching .004 in. OS on OD (second OS of 394260)
7	17	393070	1	1	1	Stud—Brace (standard)
7	17	393071	AR	AR	AR	Stud—Brace .002 in. OS on OD (first OS of 393070)
7	17	393072	AR	AR	AR	Stud—Brace .004 in. OS on OD (second OS of 393070)
7	18	393070	1	1	1	Stud—Brace (standard)
7	18	393071	AR	AR	AR	Stud—Brace .002 in. OS on OD (first OS of 393070)
7	18	393072	AR	AR	AR	Stud—Brace .004 in. OS on OD (second OS of 393070)
7	19	394940	4	4	4	Stud—Throttle body to boost venturi (standard)
7	19	394941	AR	AR	AR	Stud—Throttle body to boost venturi .002 in. OS on OD (first OS of 394940)
7	19	394942	AR	AR	AR	Stud—Throttle body to boost venturi .004 in. OS on OD (second OS of 394940)
7	20		NU	NU	NU	Not Used
7	21		NU	NU	NU	Not Used
7	22		NU	NU	NU	Not Used
7	23	396560	2	2	2	¢Venturi Assembly—Right front and left rear main
7	24	394626	1	1	1	Washer—Main venturi screw
7	25	394249	1	1	1	Screw—Main venturi
7	26	394626	1	1	1	Washer—Main venturi screw
7	27	396522	1	1	1	Screw—Main venturi (AN500-A416-22)
7	28	397174	1	1	1	Gasket—Main venturi screw
7	29	397354	1	1	1	Screw—Main venturi
7	30	394626	1	1	1	Washer—Main venturi screw
7	31	394249	1	1	1	Screw—Main venturi
7	32	394626	2	2	2	Washer—Main venturi screw
7	33	396522	2	2	2	Screw—Main venturi (AN500-A416-22)
7	34	396581	2	2	2	¢Venturi Assembly—Left front and right rear main
7	35	394626	1	1	1	Washer—Main venturi screw
7	36	396540	1	1	1	Screw—Main venturi
7	37	397174	1	1	1	Gasket—Main venturi screw
7	38	397354	1	1	1	Screw—Main venturi
7	39	394626	1	1	1	Washer—Main venturi screw
7	40	396522	1	1	1	Screw—Main venturi (AN500-A416-22)
7	41	394626	3	3	3	Washer—Main venturi screw
7	42	394249	1	1	1	Screw—Main venturi
7	43	396522	2	2	2	Screw—Main venturi (AN500-A416-22)
7	44	398037	1	NU	NU	Shaft and Lever Assembly—Throttle
7	44	361666	NU	1	1	Shaft and Lever Assembly—Throttle
7	45	P-70245	1	1	1	Washer—Throttle shaft
7	46	P-70685	1	1	1	Bushing—Lever and stop
7	47	P-70685	1	1	1	Bushing—Lever and stop
7	48	P-19627	1	1	1	Taper Pin—Stop and shaft (standard)
7	48	P-19627-1	AR	AR	AR	Taper Pin .005 in. OS on OD (first OS of P-19627)
7	49	393786	1	1	1	Packing—Throttle shaft
7	50	394902	1	1	1	Washer—Throttle shaft end
7	51	394099	1	1	1	Washer—Throttle shaft center
7	52	394099	1	1	1	Washer—Throttle shaft center
7	53	394902	1	1	1	Washer—Throttle shaft end
7	54	393786	1	1	1	Packing—Throttle shaft
7	55	P-70245	1	1	1	Washer—Throttle shaft
7	56	396531	1	1	1	Lever and Stop Assembly—Throttle balance
7	57	P-19696	1	1	1	Bushing
7	58	P-19627	1	1	1	Taper Pin—Stop to shaft (standard)
7	58	P-19627-1	AR	AR	AR	Taper Pin .005 in. OS on OD (first OS of P-19627)
7	59	P-70648	1	1	1	Spacer—Throttle balance lever and shaft
7	60	P-6699	1	1	1	Nut—Throttle shaft castle (AN310-6)
7	61	P-3679	1	1	1	Cotter Pin—Throttle shaft nut
7	62	P-70261	1	1	1	Lever—Throttle
7	63	P-6699	1	1	1	Nut—Throttle shaft castle (AN310-6)
7	64	P-3679	1	1	1	Cotter Pin—Throttle shaft nut
7	65	394392	1	1	1	Shaft—Front throttle
7	66	394902	1	1	1	Washer—Throttle shaft end
7	67	393786	1	1	1	Packing—Throttle shaft
7	68	P-70245	1	1	1	Washer—Throttle shaft
7	69	394520	1	1	1	Lever Assembly—Throttle
7	70	P-70685	1	1	1	Bushing
7	71	901004	1	1	1	Lockwasher—Throttle lever screw (AN935-10)
7	72	P-13618	1	1	1	Screw—Throttle lever (AN500-A10-10)
7	73	P-60867	1	1	1	Taper Pin—Lever to shaft (standard)
7	73	P-60867-1	AR	AR	AR	Taper Pin .005 in. OS on OD (first OS of P-60867)
7	74	P-6699	1	1	1	Nut—Throttle shaft castle (AN310-6)
7	75	P-3679	1	1	1	Cotter Pin—Throttle shaft nut
7	76	394099	1	1	1	Washer—Throttle shaft center
7	77	394099	1	1	1	Washer—Throttle shaft center
7	78	394902	1	1	1	Washer—Throttle shaft end
7	79	393786	1	1	1	Packing—Throttle shaft
7	80	P-70641	1	1	1	Washer—Throttle shaft
7	81	P-6699	1	1	1	Nut—Throttle shaft castle (AN310-6)
7	82	P-3679	1	1	1	Cotter Pin—Throttle shaft nut
7	83	396737	4	4	4	Valve—Throttle
7	84	901004	16	16	16	Lockwasher—Throttle valve screw (AN935-10)
7	85	393774	16	16	16	Screw—Throttle valve
7	86	P-19064	1	1	1	Spring—Throttle stop
7	87	P-22107	1	1	1	Stem—Throttle stop
7	88	P-22106	1	1	1	Bushing—Throttle stop
7	89	P-19064	1	1	1	Spring—Throttle stop
7	90	P-22107	1	1	1	Stem—Throttle stop
7	91	P-22106	1	1	1	Bushing—Throttle stop
7	92	397155	1	1	1	Gasket—Boost venturi to throttle body
7	93	364246	1	1	1	Venturi Assembly—Boost
7	94	394989	8	8	8	Tube—Impact
7		362500	4	4	4	Tube—Venturi (not illustrated)
7		393788	12	12	12	Packing—Venturi tube (not illustrated)
7		397476	4	4	4	Screw—Venturi tube retaining (not illustrated)
7	95	394640	3	3	3	Stud—Boost venturi (standard)
7	95	394641	AR	AR	AR	Stud—Boost venturi .003 in. OS on OD (first OS of 394640)
7	95	394642	AR	AR	AR	Stud—Boost venturi .006 in. OS on OD (second OS of 394640)
7	96	361588	1	1	1	Packing—Boost venturi bracket
7	97	362506	1	1	1	Bracket—Boost venturi
7	98	361588	1	1	1	Packing—Boost venturi bracket
7	99	362506	1	1	1	Bracket—Boost venturi
7	100	397328	2	2	2	Screw—Boost venturi bracket
7	101	397328	2	2	2	Screw—Boost venturi bracket
7	102	394626	2	2	2	Washer—Boost venturi bracket screw (AN960-416)
7	103	P-6867	2	2	2	Nut—Boost venturi bracket screw (AN310-4)
7	104	P-70565	2	2	2	Cotter Pin—Boost venturi bracket nut
7	105	394626	2	2	2	Washer—Boost venturi bracket screw (AN960-416)
7	106	P-6867	2	2	2	Nut—Boost venturi bracket screw (AN310-4)
7	107	P-70565	2	2	2	Cotter Pin—Boost venturi bracket nut
7	108	907237-K1	4	4	4	Washer—Throttle body to boost venturi stud nut (AN960-10)
7	109	P-13877	4	4	4	Nut—Throttle body to boost venturi stud (AN310-3)
7	110	394419	2	2	2	Bolt—Throttle link
7	111	394420	2	2	2	Washer—Throttle link
7	112	394430	1	1	1	Link—Throttle
7	113	394420	2	2	2	Washer—Throttle link
7	114	394421	2	2	2	Bushing—Throttle link
7	115	P-19820	2	2	2	Washer—Throttle link spring
7	116	394420	2	2	2	Washer—Throttle link
7	117	394430	1	1	1	Link—Throttle
7	118	394420	2	2	2	Washer—Throttle link
7	119	P-20351	2	2	2	Nut—Throttle link bolt (AN320-3)
7	120	P-70565	2	2	2	Cotter Pin—Throttle link bolt nut
7	121	P-2385	1	1	1	Gasket—Check valve
7	122	394488	1	1	1	Valve Assembly—Check
7	123	394276	1	1	1	Valve Assembly—Pump fill check
						ACCELERATING PUMP PARTS
7	124	396542	1	1	1	Cover Assembly—Accelerating pump
7		393940	1	1	1	Bushing—Accelerating pump shaft, inner (not illustrated)
7		360897	1	1	1	Bushing—Accelerating pump shaft, outer (not illustrated)
7		398535	1	1	1	Packing—Accelerating pump shaft bushing, outer (not illustrated)
7		397560	2	2	2	Pin—Accelerating pump shaft bushing, outer (not illustrated)
7	125	390293	1	1	1	Packing—Accelerating pump shaft
7	126	394227	1	1	1	Washer—Accelerating pump shaft packing
7	127	394226	1	1	1	Spring—Accelerating pump shaft packing
7	128	394229	1	1	1	Nut—Accelerating pump shaft packing
7	129	396537	1	1	1	Lever and Shaft Assembly—Accelerating pump
7		P-19696	1	1	1	Bushing—Accelerating pump lever, outer (not illustrated)
7		901045	1	1	1	Lockwasher—Accelerating pump lever screw (not illustrated)
7		P-2924	1	1	1	Screw—Accelerating pump lever, outer (AN500-8-10) (not illus.)
7		P-14577	1	1	1	Taper Pin—Accelerating pump lever, outer (standard) (not illus.)
7		P-14577-1	AR	AR	AR	Taper Pin .005 in. OS on OD (first OS of P-14577)
7	130	396534	1	1	1	Lever and Piston Assembly
7		P-21818	1	1	1	Screw—Lever clamp
7		P-22198	1	1	1	Washer—Lever clamp screw
7	131	394291	2	2	2	Ring—Piston
7	132	P-70150	1	1	1	Taper Pin—Pump lever set screw
7	133	396541	1	1	1	Gasket—Accelerating pump cover to throttle body
7	134	907237-K1	5	5	5	Washer—Accelerating pump to throttle body bolt (AN960-10)
7	135	396535	5	5	5	Bolt—Accelerating pump to throttle body (AN73-A6)
7	136		NU	NU	NU	Not Used
7	137		NU	NU	NU	Not Used
7	138		NU	NU	NU	Not Used
7	139		NU	NU	NU	Not Used
7	140		NU	NU	NU	Not Used
7	141	398375	1	1	1	Link Assembly—Throttle balance
7		392680	1	1	1	Bushing—Throttle balance (not illustrated)
7	142	360339	1	NU	NU	Spring—Throttle balance
7	142	392675	NU	1	1	Spring—Throttle balance
7	143	392714	1	1	1	Cover—Throttle balance outer
7	144	392725	1	1	1	Nut—Throttle balance lock
7	145	394414	1	1	1	Guide—Throttle balance
7	146	392726	1	1	1	Screw—Throttle balance shoulder
7	147	P-19820	1	1	1	Washer—Throttle balance spring
7	148	907239-K1	1	1	1	Washer—Throttle balance shoulder screw (AN960-416)
7	149	907237-K1	1	1	1	Washer—Throttle balance link to lever (AN960-10)
7	150	P-13877	1	1	1	Nut—Throttle balance castle (AN310-3)
7	151	P-70565	1	1	1	Cotter Pin—Throttle balance nut
7	152	396536	1	1	1	Link—Throttle lever to pump lever
7	153	P-18616	1	1	1	Bolt—Throttle lever to pump lever link
7	154	P-70229	1	1	1	Washer—Throttle lever to pump lever link spring
7	155	P-16019	1	1	1	Washer—Throttle lever to pump lever link bolt
7	156	P-16014	1	1	1	Nut—Throttle lever to pump lever link bolt
7	157	393363	1	1	1	Cotter Pin—Throttle lever to pump lever link nut
7	158	P-18616	1	1	1	Bolt—Throttle lever to pump lever link
7	159	P-70229	1	1	1	Washer—Throttle lever to pump lever link spring
7	160	P-16019	1	1	1	Washer—Throttle lever to pump lever link bolt
7	161	P-16014	1	1	1	Nut—Throttle lever to pump lever link bolt
7	162	393363	1	1	1	Cotter Pin—Throttle lever to pump lever link nut
7	163	P-60000	1	1	1	Plug—⅜-24 taper seat
7	164	P-60000	1	1	1	Plug—⅜-24 taper seat
7	165	P-8508	1	1	1	Plug—¼-inch pipe (AN913-1)
7	166	P-8508	2	2	2	Plug—¼-inch pipe (AN913-1)
7	167	P-61195	2	2	2	Plug—¼-28 taper seat
7	168	P-60000	1	1	1	Plug—⅜-24 taper seat
7	169		NU	NU	NU	Not Used
7	170	393399	1	1	1	Plug—5/16-24 taper seat
7	171	393399	1	1	1	Plug—5/16-24 taper seat
7	172		NU	NU	NU	Not Used
7		P-20166	1	1	1	Plug—5/16-24 taper seat (not illustrated)
7		P-20165	1	1	1	Plug—¼-28 taper seat
7	173		NU	NU	NU	Not Used
7	174		NU	NU	NU	Not Used
7	175	393647	1	1	1	Plug—10-32 taper seat
7	176	P-9201	1	1	1	Bleed—Drain
7	177	396178	1	1	1	Plate—Specification
7	178	P-16630	2	2	2	Screw—Specification plate drive (AN535-0-3)

¢—Variable Parts, Refer to Specification Sheet for Size.
*—Special Parts, Refer to Specification Sheet for Part Number.
AR—As Required.

OS—Oversize.
OD—Outside Diameter.
NU—Not Used

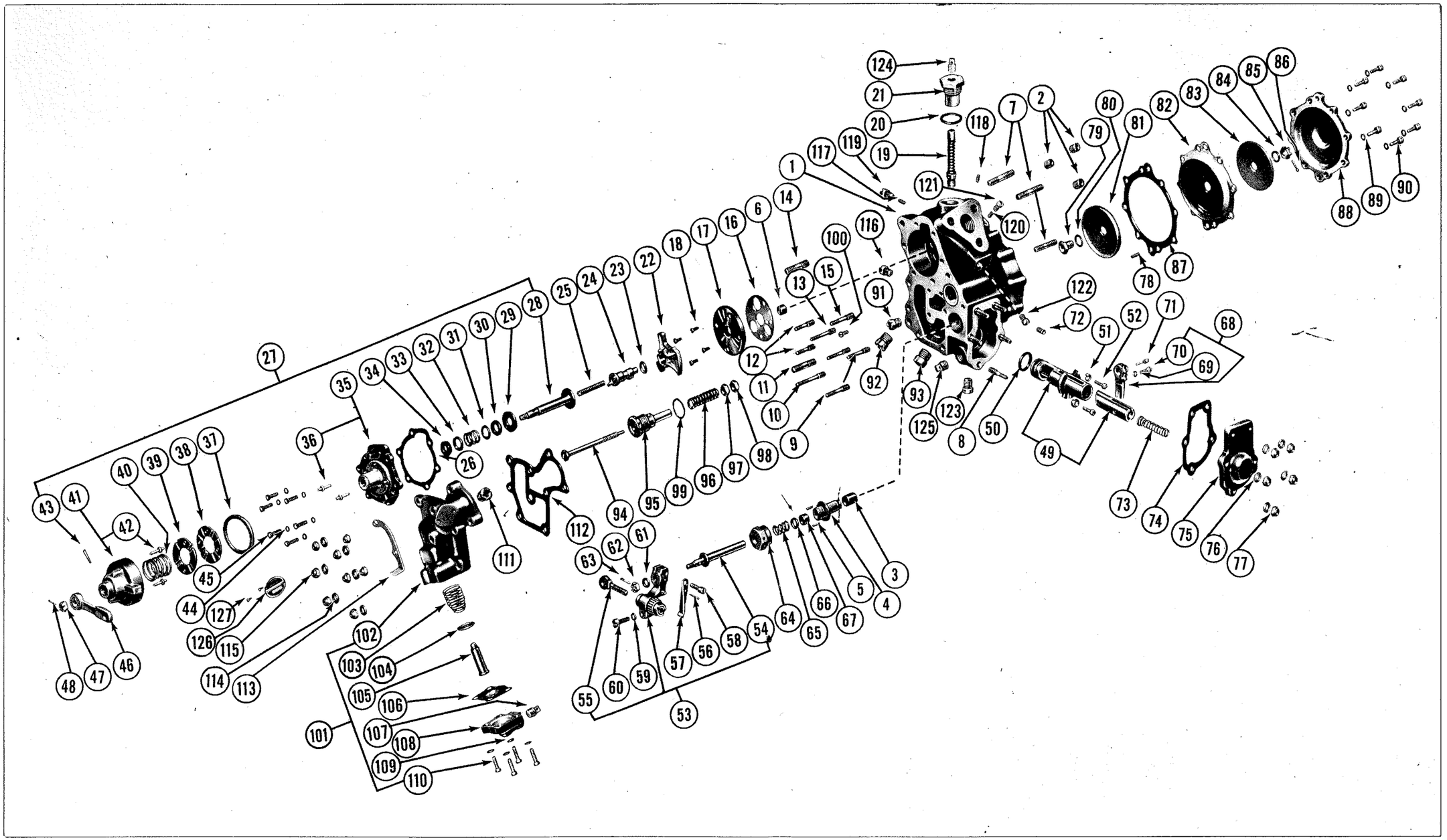


FIGURE 6
FUEL CONTROL UNIT

Parts List Number

392434

BENDIX PRODUCTS DIVISION

OF BENDIX AVIATION CORPORATION

SOUTH BEND, INDIANA

ELECTRIC PRIMER VALVE — Assembly Parts List

DATE: (12-27-44)

Figure Number	Index Number	Bendix Part Number	Number Required	Nomenclature
8	1	393656	1	Adapter Assembly—Primer
8	2	392990	1	Valve Assembly
8	3	398629	1	Gasket—Seat
8	4	392992	1	Spring—Valve
8	5	392985	1	Seat
8	6	392761	1	Washer—Solenoid
8	7	392989	1	Solenoid Assembly
8	8	393105	1	Housing Assembly
8	9	392767	1	Insulation
8	10	392762	1	Insulator
8	11	394629	1	Spring & Pin Assembly—Contact
8	12	392765	1	Washer—Insulator
8	13	392964	1	Washer
8	14	392766	1	Screw—Contact spring & pin
8	15	393194	1	Washer—Housing & seat
8	16	P-60303	1	Nut—Housing & Seat (AN365-D-1032)
8	17	393360	1	Washer—Insulation
8	18	393361	1	Ring—Temperature safety
8	19	P-8508	1	Plug—⅛" pipe (AN913-1)
8	20	393706	1	Plate—Name
8	21	P-16630	2	Screw—Name plate drive (AN535-O-3)

¢—Variable Parts, Refer to Specification Sheet for Size.
*—Special Parts, Refer to Specification Sheet for Part Number.
AR—As Required.
OS—Oversize.
OD—Outside Diameter.

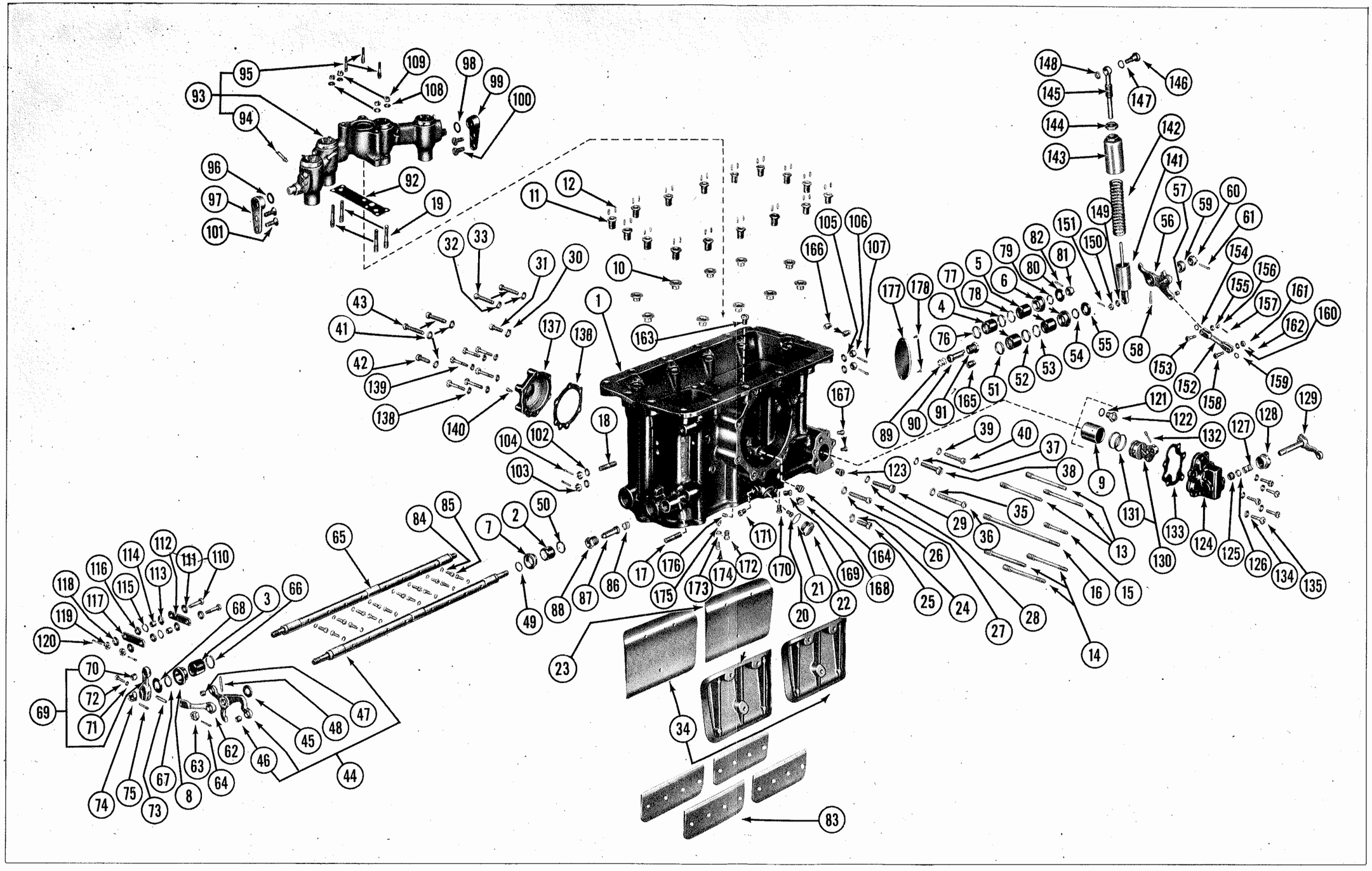


FIGURE 7
THROTTLE UNIT

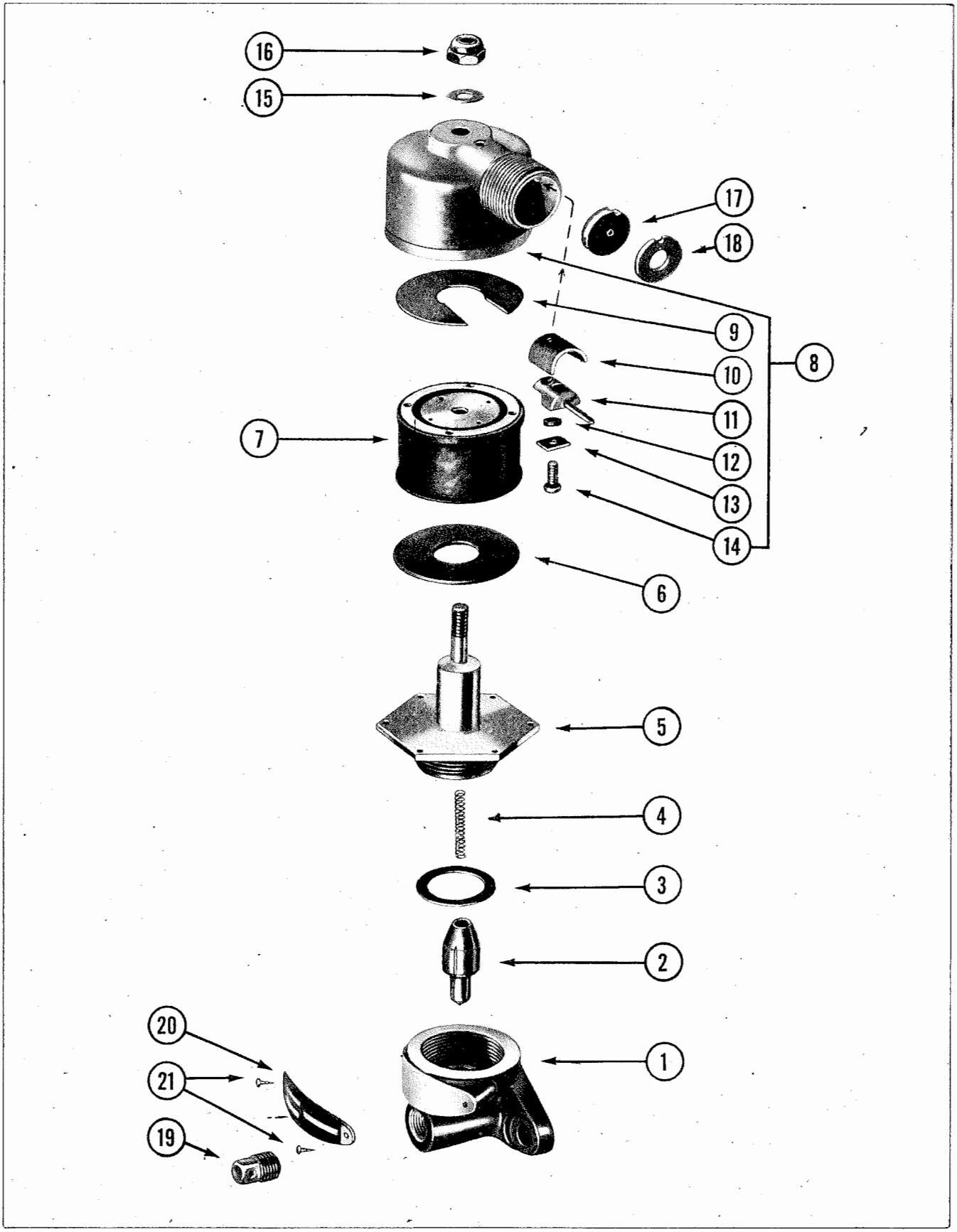


FIGURE 8
ELECTRIC PRIMER VALVE

Parts List Number

395938

BENDIX PRODUCTS DIVISION

OF BENDIX AVIATION CORPORATION

SOUTH BEND, INDIANA

AUTOMATIC MIXTURE CONTROL — Assembly Parts List

DATE: 11-2-49

Figure Number	Index Number	Bendix Part Number	Number Required	Nomenclature
9	1	361054	1	Housing
9	2	P-60129	1	Nut—Bellows housing spanner
9	3	360515	1	Bellows Assembly
9	4	360533	1	Nut—Bellows lock
9	5	360531	1	Washer—Needle to bellows
9	6	361162	1	Needle Assembly
9	7	360530	1	Ring—Needle retaining
9	8	392737	1	Gasket
9	9	364490	1	Base Assembly
9	10	P-22149	1	Packing
9	11	P-60961	1	Seal—Lockwiring lead

¢—Variable Parts, Refer to Specification Sheet for Size.
*—Special Parts, Refer to Specification Sheet for Part Number.
AR—As Required.
OS—Oversize.
OD—Outside Diameter.

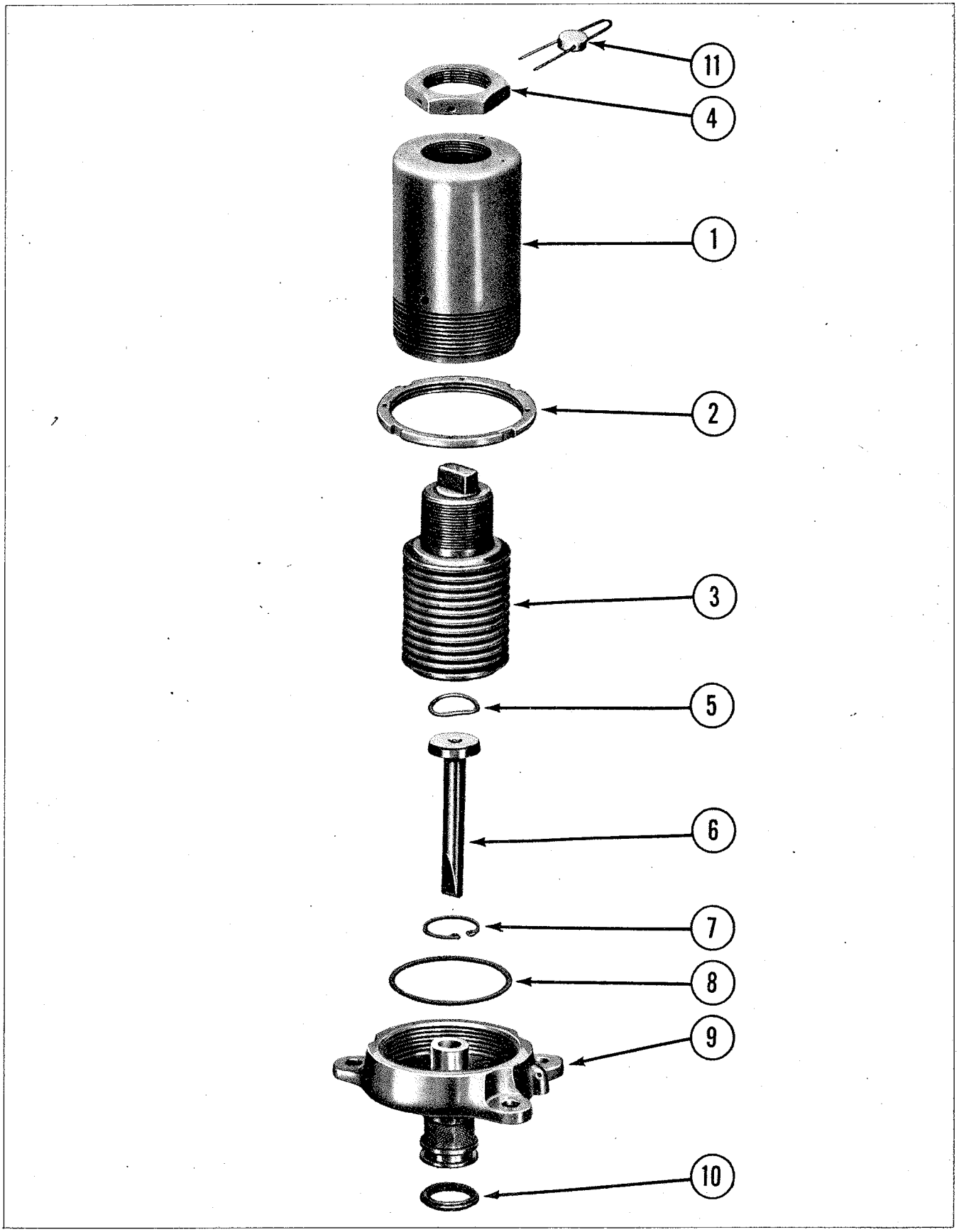


FIGURE 9
AUTOMATIC MIXTURE CONTROL UNIT

Parts List Number
390922
391017

BENDIX PRODUCTS DIVISION
OF BENDIX AVIATION CORPORATION
SOUTH BEND, INDIANA

AUTOMATIC MIXTURE CONTROL — Assembly Parts List

DATE: (9-9-49) (9-9-49)

Figure Number	Number Index	Bendix Part Number	Number Required Per Unit		Nomenclature
			390922	391017	
10	1	361627	1	NU	Needle
10	1	362329	NU	1	Needle
10	2	399232	1	1	Spring—Plunger
10	3	P-61250	1	1	Plunger
10	4	399092	1	1	Bellows Assembly
10	5	P-22145	1	1	Washer—Felt
10	6	363973	1	1	Washer—Needle retaining
10	7	360530	1	1	Ring—Needle retaining
10	8	390200	1	1	Housing
10	9	P-22148	1	1	Nut—Adjusting lock
10	10	P-60129	1	1	Nut—Spanner
10	11	P-22151	1	1	Screen
10	12	392737	1	1	Gasket—Housing to base
10	13	399220	1	1	Base Assembly
10	14		NU	NU	Not Used
10	15	P-22149	1	1	Packing
10	16	P-60961	1	1	Seal—Lead

¢—Variable Parts, Refer to Specification Sheet for Size.
*—Special Parts, Refer to Specification Sheet for Part Number.
AR—As Required.
OS—Oversize.
OD—Outside Diameter.
NU—Not Used

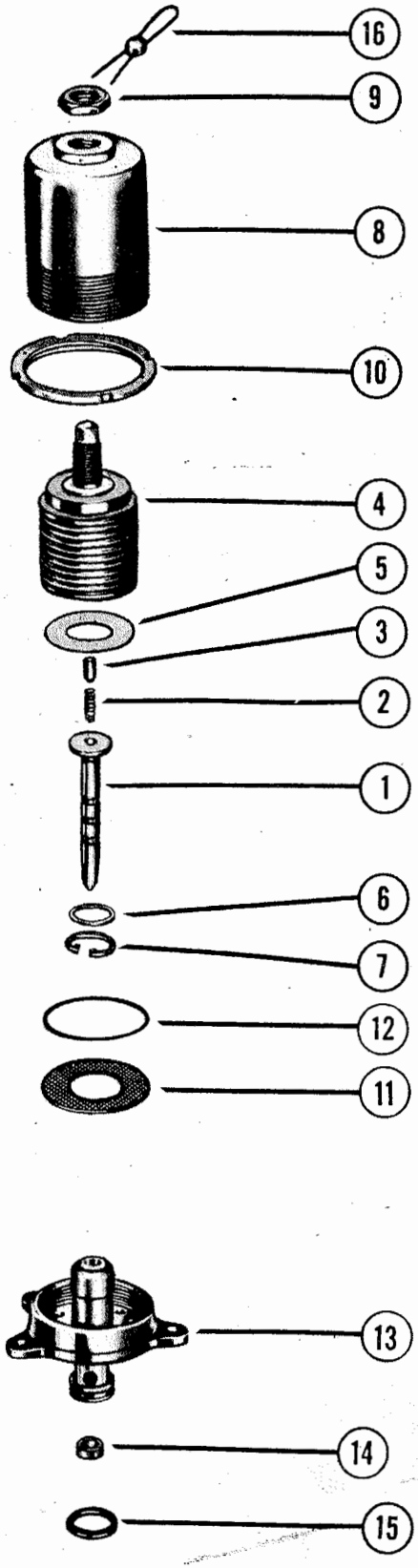
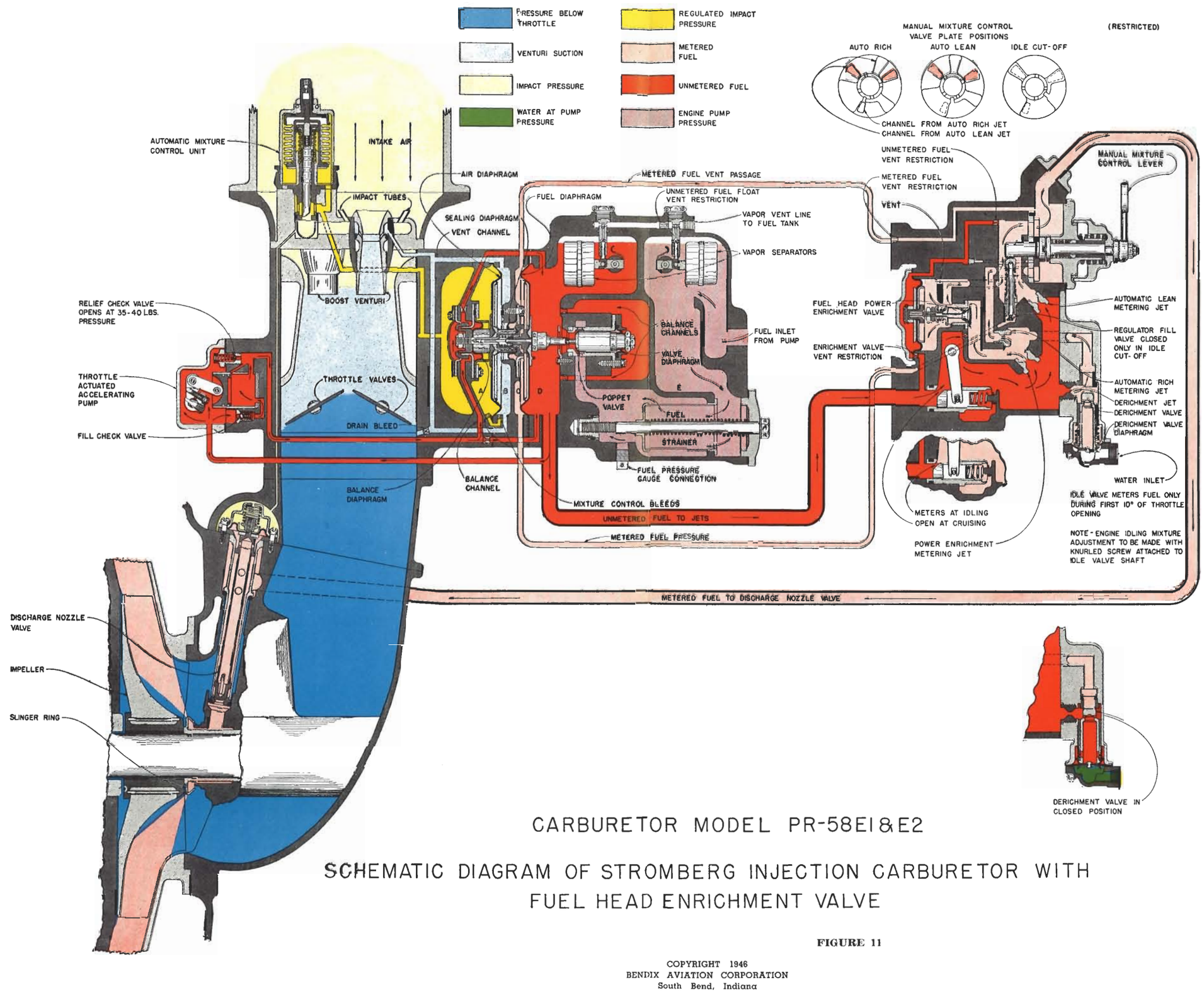


FIGURE 10

AUTOMATIC MIXTURE CONTROL UNIT

SCHEMATIC DIAGRAM



CARBURETOR MODEL PR-58E1&E2

SCHEMATIC DIAGRAM OF STROMBERG INJECTION CARBURETOR WITH FUEL HEAD ENRICHMENT VALVE

FIGURE 11

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